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SIXTH ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

OF

MASSACHUSETTS.

JANUARY, 1875.

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BACT. & PHYS.

MEMBERS OF THE BOARD.

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T. B. NEWHALL,	OF LYNN.
C. F. FOLSOM,	OF BOSTON, <i>Secretary.</i>

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Commonwealth of Massachusetts.

STATE BOARD OF HEALTH, BOSTON, January 20, 1875.

Hon. GEORGE B. LORING, *President of the Senate of Massachusetts.*

SIR:—I have the honor to present to the legislature the Sixth Annual Report of the State Board of Health of Massachusetts.

Very respectfully,

Your obedient servant,

CHARLES F. FOLSOM, M. D.,

Secretary of the State Board of Health.

GENERAL REPORT OF THE BOARD.

*To the Honorable the Senate and the House of Representatives of
Massachusetts.*

The State Board of Health herewith presents its Sixth Annual Report.

Early in the past summer, the State Board of Health, the community, and sanitary science, suffered the great loss of the death of Dr. George Derby, who died June 20, 1874. How great this loss was only those can know who knew his untiring industry, his well-directed enthusiasm, his high sense of honor, and his devotion to his convictions of duty.

Resolutions of respect to his memory have reached us from both shores of our continent. "To a well-trained mind there were added an honesty of purpose, an enthusiasm for his work, a firmness of character, and a personal address which inspired others to help him in his good work, and won for him the respect and regard of his professional colleagues. The reputation of such a man is necessarily not so brilliant or widespread as that of one whose services have been of a more conspicuous character; but a slight consideration of what Dr. Derby accomplished, directly by his example in Massachusetts, and indirectly by his influence on public hygiene without regard to state limits,—an influence not yet spent, nor likely to be spent in this generation,—shows how richly he merits the long and grateful remembrance of his countrymen."—*The Nation*.

At a meeting of the Board, June 22, 1874, the following address by the chairman, Dr. Henry I. Bowditch, was read.

It was also, by unanimous vote, printed in circular form for distribution :—

Gentlemen of the State Board of Health :

A few days since, I warned you of the serious illness of our dear friend and honored Secretary, DR. GEORGE DERBY. It is with great sorrow that I have summoned you again in consequence of his death.

Permit me to recall to your notice some of the more salient points in his history, with many of which, you, who have been associated with him in this Board, are already partially or perchance fully acquainted.

Dr. Derby was born in Salem, in 1819; he was the son of John Derby, an eminent merchant of that city.

He took his degree from the Harvard Medical School in 1843. For many years he practised very quietly in Boston, but was little known by the public, or to the profession, until the late war brought to light his latent energy, and his admirable character.

The first call of President Lincoln upon the patriotism of the country at the commencement of the civil war, found our friend prompt and determined to do his whole duty. He entered again with praiseworthy zeal into all the work of student life. He took special lessons in practical surgery from our most eminent surgeons, and, with more than youthful enthusiasm, studied out the improvements in medicine and surgery that had been brought forward during the many years since his pupilage, from 1838 to 1843. This act marked two of those traits of character which we, his associates on the Board of Health, have seen and admired so much during our intercourse with him, viz. : his conscientiousness, and his thoroughness in his dealings with any question. He was unwilling to undertake the care of our patriot soldiers without fitting himself in the most perfect manner for the task. He received from Governor Andrew the commission of surgeon of the 23d regiment of the Massachusetts Volunteers. He went through the whole war without a furlough, and was always ready to sacrifice himself for the good of the soldiers. He was fearless in the presence of danger, performing important operations on the field while under fire, with a perfect coolness and deliberation, when others, superior to him in authority, shrunk from the ordeal to which his sense of professional duty summoned him.

Having thus served, with a reputation for ability unsurpassed by any one, he left the army at the termination of the war, a man comparatively broken down in health, and with the prospect of commencing anew his professional life. For months, by most careful regimen, and the daily use of quinine, he had fought against the insidious encroachments of malarial disease.

When the war closed, the reaction took place, in a corresponding depression of his health.

The government, fully appreciating his worth, and desirous of aiding him in his perfect recovery, appointed him to the charge of the National Soldiers' Home, at Augusta, Maine.

After several months' residence there, having partially, at least, regained his vigor, he resumed practice in Boston. He came back to us a man of noteworthy fame, as a patriot, as an able and fully-practised surgeon, and a most high-toned gentleman.

Soon after his return he published some papers relating to hygiene, and he was called to fill the post of surgeon at the City Hospital. He also was made Professor of Hygiene, at Harvard College.

During the war, he married Miss Parsons, granddaughter of the celebrated Theophilus Parsons, formerly Chief Justice of the Supreme Court of this State. Dr. Derby left a widow and two children.

June 21, 1869, just five years ago, the legislature passed the Act establishing the State Board of Health.

For two years previously Dr. Derby edited the Reports to the legislature relating to the births, marriages and deaths in Massachusetts. In the preface to the Report, in 1867, the Secretary of State had used the following language in reference to Dr. Derby, that "during the late war he was four years in active service, with the largest reputation as surgeon."

His publications, as well as his acquired reputation at the State House and abroad, readily pointed him out as the person most fitted, on the score of his manliness, ability, and integrity, to be Secretary of the new Board. He, in fact, had no rival.

I need not remind you of all that he has done for us; of the great works he has inaugurated, and successfully carried forward. But none of us, I suspect, even now realize how devoted he has been; we all know how often and how perfectly we trusted him. We felt that the honor of our Board would be cautiously and firmly sustained. We remember his genial and commanding presence; his indefatigable zeal in everything that was ordered by the Board. We were sure of him, as the most reliable person we could have. How much the present position of the Board, as a motive-force in the community, depends on his really wonderful faculty of meeting and of moulding men, we shall never exactly know. For my own part, gentlemen, words would fail me to give you my idea of the debt we owe to him. He guarded our honor and safety with so jealous a care that sometimes I was inclined to think him unduly cautious. I never had any forebodings in regard to the safety and ultimate success of the Board, for I believe that State, or Preventive Medicine, has taken so deep a root in the conscience of the English-speaking race, that hereafter, boards of health, or in other words, for the prevention of disease, must forever exist; and they will have more and more weight upon the policy of states and of nations, as well as upon the private habits of individuals.

And now, gentlemen, what is the lesson that comes to us from the life-work of our dear friend and co-laborer in a most noble cause?

Why, simply this: that we should one and all go on with renewed zeal and with an untiring devotion that shall be worthy of him. Let us make his course our example in our future career. If we do this, I have no fear; for the future of any cause must be bright, provided it be carried forward intelligently, and with the single endeavor to do honestly and justly the duty of the hour, as our friend Derby always did his.

God grant his grace to each one of us, and enable all of us to feel, during our future connection with the Board, the beauty of the example left to us by the life of our dead associate.

After the death of Dr. Derby, Dr. F. W. Draper, of Boston, who had been for some years intimately associated with him in sanitary investigations, and who had made several valuable contributions to the reports of the Board, was elected temporary Secretary, he having kindly consented to serve for three months. He fulfilled the duties of the office faithfully and

efficiently, and much regret was felt by the members of the Board in severing official connection with so able an associate. He retired from office September 12, 1874, when the present Secretary was elected.

LOCAL BOARDS OF HEALTH.

The Board has evidence, from time to time, that local boards in various parts of the State are not aware of the extent of their large powers, and that they also are often reluctant to exercise the great power allowed to them by the statutes. They not infrequently, too, make the mistake of supposing that the law authorizing the State Board of Health to grant hearings and to pass judgment on complaint against any persons engaged in any of the so-called noxious trades, takes away from themselves all responsibility in such matters, although the powers of local boards remain precisely as they were before the passage of said Act, and are fuller and more summary than those of the State Board.

It is to be desired that these statutes should be simplified, and that local boards of health should always be elected or appointed which are not connected with their respective town or city governments.

In England, at the present time, there is a serious question whether the word "may" would not be beneficially changed to "must" in the laws granting authority to boards of health.

DRAINS AND SEWERS.

By the last report of the board of health of the city of Boston, and by the statements found in the present report under the head of health of towns, from our correspondents in East Boston, Charlestown, Salem, Woburn, Worcester, and several of the smaller towns, it may be seen how great is the magnitude of this question, and how important its bearing upon the public health.

The most recent experiments tend to show that we have been vastly overrating the oxidizing and disinfecting properties of air, water and earth. There can be no question of the fact that we are drinking water and breathing air contaminated by sewage and sewage emanations; and the fact is admitted, that both air and water may be polluted to a danger-

ous degree without perceptible change in taste, color or smell. We must not deceive ourselves because such poisons do not "slay like the sword," because long habit gives us a certain kind of immunity from evil results, and because, in our new and sparsely populated country, we have a soil not yet saturated with the filth of centuries.

Upon the many hundred acres of mud and marsh exposed at low tide in and near Boston, the sediment from the sewage of a large part of that city, of Cambridge, of part of Somerville, and of the whole Miller's River basin, is deposited in great quantities, setting free sulphuretted hydrogen, "carbo-ammoniacal" gases, etc., into the air breathed by the inhabitants of the metropolitan district. In the other cities referred to, evils will be found correspondingly great.

The remedies must be determined to a great degree for each particular case ; but poisonous sewage emanations might at least be kept out of our dwellings if the drainage of all houses were inspected, before occupancy, by the local health officers ; and it would be well if all matters relating to drainage and sewerage could be referred to independent boards of health ; or, in the case of very large cities, if there could be a central executive bureau, a "Board of Works," so that there would be a more thorough coöperation in the different departments.

As to the final disposition of sewage, it is not yet possible to say definitely what one of the many plans now suggested and tried in different parts of the world will become generally adopted as possessing the least number of disadvantages, and the question must often be decided with reference to purely local considerations.

HYDROGRAPHICAL SURVEY.

From a consideration of the last-mentioned subject, and upon purely economic grounds, the Board desires to call the attention of the legislature to this subject. The storage and supply of water for domestic and manufacturing purposes and the construction of systems of sewerage cannot be properly regulated by individual cities and towns without prejudice to the health or interests of other places. This can only be done by a comprehensive survey of large areas of country,

as has been already suggested in the report of the state board of education on the proposed survey of the Commonwealth.

In connection with this survey, and under the section entitled "Biological," the Board would urge that arrangements should be made for a sanitary survey of the State. The Board would also draw the attention of the legislature to the report made by our late Secretary, Dr. Derby, upon the waters in the various ponds of the State, and to his suggestion that prompt measures should be taken by the legislature in order to keep these waters perfectly pure for future generations. [*Fourth Annual Report of the State Board of Health of Massachusetts*, pp. 107, 108.]

THE SALE AND USE OF POISONS.

The statutes provide that whoever "sells any arsenic, strychnine, corrosive sublimate or prussic acid, without the written prescription of a physician," shall keep a record of the date, etc., of such sale and of the name of the buyer.

We would respectfully suggest that no poisonous drug should be sold without a written order either from a physician or from the person requiring it.

The fact that several deaths have occurred from the use of chloroform during the past year renders appropriate our calling attention to the potency of this drug, and to the extreme care thought to be necessary in its administration in those places where it is used to produce complete anæsthesia. The use of so dangerous a remedy should be reserved for those cases where the safer agent is manifestly unsuitable or its use impracticable. Although chloroform is used by many English and continental surgeons, without their ever having had, during long years of experience, any fatal result from it, yet it must be remembered that the precautions observed by them are numerous; that they have a large corps of skilled assistants; that we have a much safer agent in ether; and that unforeseen and sudden collapse does occur and produce a fatal result, although rarely, in strong, healthy persons from the inhalation of chloroform, while such cases are thus far entirely unknown of ether.

THE LAW CONCERNING SLAUGHTER-HOUSES AND NOXIOUS
AND OFFENSIVE TRADES.

The hearing in the case of Messrs. J. P. Squire & Co. was closed December 29, 1873, and some time after the efforts of the Board had failed to induce the proprietors of the large swine-slaughtering establishments in the Miller's River basin to establish a large abattoir farther from the centres of population and nearer to a large body of water. The consideration of this case was taken up first in order at the request of the petitioners; and the testimony and arguments, as published by Messrs. J. P. Squire & Co., occupy 596 pages of closely-printed octavo.

That a nuisance, in the broadest sense of the term, was proved to exist in the Miller's River district there could be no manner of doubt; nor did the evidence fail to indicate what were the factors in the case. It was clearly shown that the gaseous products and emanations from rendering putrid grease, from trying out both fresh and rancid lard, from boiling dead animals, from foul pigpens and transportation cars, from scalding vats, from great quantities of sewage and decomposing animal matter exposed to the action of the air while spread out over large surfaces of impervious mud, and from the dock mud itself, were contaminating the air to a degree intensely annoying to the senses and extremely dangerous to the public health.

The odors, generally speaking, were shown to be distinguishable, if taken singly, although their combination in many cases rendered it impossible to trace the offence of a given time to its proper source. They were shown, too, not to be an exception to nature's law, and to be diffused to some degree in all directions, whatever the barometric pressure of the atmosphere or the direction of the prevalent wind, if not blowing violently. When the winds were light and variable, forming currents and counter-currents of air, the noxious odors were as capricious as the winds themselves in the spots (often quite circumscribed) where they became noticeable; and, by the use of high chimneys, they were sometimes offensive at a distance when scarcely perceptible at their source. They also existed at times in sharply-defined *strata*,

so as to be nauseating at one part of a house and not disagreeable in another; and this fact held good of persons even in different parts of the same room.

But the Board had before them other questions more difficult of solution, before they could decide whether or not three-quarters of a million hogs could be annually slaughtered and hundreds of tons of lard rendered, within two miles in an air line from the State House, without danger to the public health and public welfare.

In the first place, it was not possible to say to what degree each one of the contributing causes was responsible for the sum total of offence, and great advantage was anticipated from the filling-in of the flats, and from the other improvements which were then in progress. It was thought, too, that the completion of these improvements would narrow the inquiry as to the relative importance of such causes of offence as might remain.

In the second place, there were no justifiable grounds for interfering with private interests while there remained so much doubt as to the precise origin of this offence, and while it was contended that, with a proper system of sewerage and with sufficient care in conducting the various "noxious trades," all sources of complaint would disappear.

The members of the Board have, from time to time, made the Miller's River basin, and the various establishments complained of, the subjects of careful personal inspection, but they have felt obliged to reserve final judgment, as they have always done in similar cases, and as they are now doing with regard to other establishments against which formal complaints have been made, and where hearings have already been held.

After the protracted hearing in the case of Messrs. Squire & Co., decision in reference to that establishment, and all further action in the cases of the others complained of, was postponed for the following reasons:—

Mr. Ransom C. Taylor, of Worcester, had appealed to the Supreme Court* against the decision of this Board, of August

* Claiming that the law under which the Board acted (Acts and Resolves passed by the General Court of Massachusetts in the year 1871, chap. 167) was unconstitutional, and that the proceedings were irregular.

27, 1873, whereby it was ordered that he "cease and desist" from the boiling of bones and meat on the premises then occupied by him. Pending a decision in this case, the Board acted under eminent legal counsel in postponing any further judgments.

After Mr. Taylor had abandoned his case and had consented to a perpetual injunction, other reasons influenced the Board to still further delay their decision.

It was fully proved that a very offensive odor emanated from the vicinity of the establishment of Messrs. J. P. Squire & Co. Whether this odor was caused by the establishment in question, by the extensive and very foul tide-water basins, by the establishments where the rendering of house-grease, etc., is carried on without proper facilities for avoiding offence, or by all three causes in common, has not as yet been passed upon by the Board.

In the meantime, by direction of the legislature, these basins were in the process of filling-in, sewers were making, and new means of avoiding offence had been introduced by the firm of Messrs. Squire & Co., while others were fast following their example. These improvements are not yet completed, but are making rapid progress.

In view of these facts, of the great number of employes to whom maintenance is afforded, and of the large amount of meat which is furnished at a low rate to very many people, on the one hand, and of the right of a community to unpolluted air, on the other hand, and in view of the undisputed fact that the offensive odors have very decidedly diminished, it is believed that the Board has acted wisely in reserving its decision in the case of Messrs. J. P. Squire & Co.

With regard to the others complained of, who are using the best methods known to them for avoiding offence, it would, in the opinion of the Board, be equally unwise to pass judgment, and, consequently, unadvisable to have hearings at present.

With regard to others still, however, who have not at any time used these improved methods, some of whom render only house-grease and refuse from provision stores, there has been no reason why the Board should not have hearings, if the petitioners had desired to present the cases.

Petitions had been entered complaining against the following-named parties :—

J. P. Squire & Co. (*hog-slaughtering, pork-packing and lard-rendering*).

Chas. H. North & Co. (*hog-slaughtering, pork-packing and lard-rendering*).

The Boynton Packing Co. (*hog-slaughtering, pork-packing, and lard rendering*).

Lincoln, Chamberlain & Co. (*pork-packing and lard-rendering*).

William Reardon (*rendering*).

Thomas Spellman (*rendering*).

Charles O'Neill (*rendering*).

Thomas Shevlin (*rendering*).

Garrett Barry (*rendering*).

From the inspections made from time to time by the Board, it appeared that the first three have been and are using all the means in their power, and are ready to adopt any suggestions of the Board, to so conduct their business as to make it inoffensive.

The rest allow the volatile products from rendering to escape freely into the surrounding air, a course which necessarily gives rise to bad smells. These gaseous products from subjecting fats to high temperatures are highly irritating, slowly oxidizable, and to be perceived at considerable distances. Such have been exceptionally the sources of annoyance during the past summer to people living in Charlestown, Somerville, Cambridge, and on the westerly side of Beacon Hill, in Boston.

In order to ascertain the wishes of the petitioners, the secretary was directed to confer with their counsel, who stated subsequently, at a meeting of the Board, that he had not been able to ascertain that any of them wished to proceed farther, to so great a degree had the nuisance been abated.* One of the petitioners, still resident in Cambridge, has expressed a similar opinion; and the rest, seven in number, have been

* Some facts bearing upon this subject will be found under the head of "Health of Towns," from correspondents in Charlestown and Somerville.

addressed by letter. In the two cases, where replies have been received, there have been expressions of opinion unfavorable to further proceedings against the parties complained of, and in regard to whom no hearings have been held, although dissatisfaction was expressed that a condemnatory decision had not been arrived at in the case of Messrs. J. P. Squire & Co. Under the existing laws, therefore, this Board can take no action in these cases unless new complaints be made.

The Board has endeavored faithfully, and at the cost of considerable time and trouble, to ascertain, as nearly as possible, the precise amount of annoyance caused during the past year to the people living near the Miller's River basin. They have made careful inquiries of persons living in Charlestown, Cambridge, Somerville and Boston, and also of others who frequently pass the slaughtering and rendering establishments; and they cannot but feel that the results of these inquiries have justified their delay in the matter.

The long sewer built by the cities of Cambridge and Somerville, and emptying just below "Craigie's Bridge," has afforded temporary and partial relief from the odors formerly so annoying, inasmuch as the flats now irrigated by the refuse of the Miller's River basin are smaller in extent and less incompletely washed than those over which it was formerly spread. The odors arising from the bed of the river exposed at low tide in the vicinity of the mouth of this sewer have already become the source of serious annoyance, and the sewage exhalations cannot fail to become more dangerous to health each successive year, until some radical change be made either by carrying the sewer out to deep water or by filling-in the flats. This condition of things was predicted by the joint commission, consisting of the Board of Harbor Commissioners and State Board of Health, when they recommended a different course for the sewer and its final emptying into Mystic River.

In the vicinity of the great swine-slaughtering establishments is a large triangular tide-water basin. The owners of this property, Messrs. Walker, Bean & Wilbur, have failed to fill it in to the level of the adjoining newly-made land; and a large, open, filthy cess-pool has thus been made, with a

surface area of about six thousand square feet, into which two large sewers are discharged. The mouths of these two sewers are quite open and unconnected with the open end of the efferent sewer. This is a very serious evil, but one in regard to which the State Board of Health has no authority.

The three methods used by the three large slaughtering establishments for rapidly oxidizing and disinfecting gases and liquids before allowing them to escape have been devised with care and constructed with skill; but it will be impossible to speak definitely of their absolute or comparative efficacy, without careful, scientific determinations.

The apparatus of Messrs. Charles H. North & Co. for inoffensively evaporating the "soup" or "liquor" from rendering tanks,* which contains about eight per cent. of solid matter, deserves careful consideration from all sanitary authorities. It is claimed, too, that glue can be made by this process so as to yield a good profit. Many tons of this "soup" escape daily into the waters about Boston, polluting them to a degree which cannot readily be estimated; and some method should be devised and enforced for getting rid of them, if possible.

To what extent noxious trades should be allowed in the centres of large populations, without supervision of any kind, and to what degree they should be compelled to adopt apparatus, without which nuisance cannot be avoided, are questions which admit of but one answer. The supervision of this Board, which has been rendered necessary in order to enable its members to form intelligent opinions as to the questions now at issue, has accomplished a great deal; but there should be something to take its place when that is withdrawn at the time of the final decision.

At the session of the last legislature the following Act was passed:—

[Chapter 308.]

AN ACT to amend Chapter one hundred and sixty-seven of the Acts of eighteen hundred and seventy-one, relating to Slaughter-houses and Offensive Trades.

Be it enacted, &c., as follows:

SECT. 1. Sections one and two of chapter one hundred and sixty-seven of the Acts of eighteen hundred and seventy-one are hereby

* Compare the Report on the Brighton Abattoir, page 15.

amended, by striking out the words "containing more than four thousand inhabitants," wherever they occur.

SECT. 2. This act shall take effect on its passage.—[*Approved June 5, 1874.*

In accordance with this act, there have been two petitions sent to the Board during the past year.

In the case of Mr. J. H. Corthell, of South Scituate, where seven petitioners complained that a slaughter-house, two hundred and forty-eight feet from the nearest of their three houses, was a nuisance, the Board reserved judgment in order to give the remonstrant opportunity to get rid of the obnoxious features of his business, as he promised to do.

In the case of Messrs. Randall and Ricker, of Reading, eight petitioners complained that the business of rendering tallow and boiling bones, was so conducted as to be "a nuisance in the meaning of the law." Loose, movable covers, in some cases with water-joints, had been adopted by the remonstrants for their rendering-tanks, and the volatile products of their processes were passed under the furnace fires without first condensing the aqueous vapor. The effect of this was to reduce the maximum distance at which offensive odors could be perceived, from about three miles to about one mile, and the distance at which they were frequently quite annoying, and even nauseating, from about three-fourths to about one-fourth of a mile. By climbing to the top of the remonstrants' chimney, members of the Board satisfied themselves that, as a fact, the destruction of the causes of offense was far from complete. There seemed no feasible way of remedying this fault; and the Board ordered that Messrs. Randall and Ricker should cease and desist from the business of bone-boiling, on and after April 1st, 1875, reserving their judgment as regards the tallow-rendering.

There has been no action as yet taken under the law * authorizing three or more persons to associate themselves together, constitute a corporation, and build an abattoir for the purpose of swine-slaughtering.

* Acts and Resolves passed by the General Court of Massachusetts in the year 1874. Chap. 295. "An Act concerning swine-slaughtering associations."

THE BRIGHTON ABATTOIR.

The continued success with which the Butchers' Slaughtering and Melting Association so inoffensively converts a vast quantity of disgusting matter into a valuable material for fertilization, is a subject of congratulation; and their pecuniary profit is fully earned by the skill, care, watchfulness, and cleanliness, with which their business has been conducted. The directors are just introducing apparatus for completely evaporating all of the "soup" from the rendering-tanks, instead of allowing it to escape into the Charles River, a measure of great sanitary importance.

A new and important industry has arisen, too, in making from the finest qualities of the tallow, from the abattoir, very palatable "pearl butter."

The objects aimed at in establishing the abattoir have been in great measure accomplished. A large number of nuisances have been abated, but something remains still to be done. In November, 1874, there were in Brighton fifteen slaughter-houses, being about forty less than were there four years ago. One has since been closed by the city Board of Health, and another for other reasons. Of the remaining thirteen, four were used for killing calves, one for sheep, and in the rest nearly six hundred cattle were killed each week. Their condition ranges from very bad to indifferent; but the Board has not felt willing to exercise the discretionary power given it by the statutes,* and require the proprietors to slaughter upon the premises of the Butchers' Slaughtering and Melting Association, while they could not do so without themselves putting up new buildings on those grounds, which they felt unable to do. On the first of January, 1875, the business of the largest two of these establishments was transferred to the abattoir. The proprietors of them had slaughtered two-fifths of the whole number of cattle killed in the old slaughter-houses then left in Brighton, and had kept their premises in a less offensive condition than the others had kept theirs. The latter are more or less subjects of complaint, and there is now ample room at the abattoir for all the slaughtering of

* Acts and Resolves passed by the General Court of Massachusetts in the year 1870. Chap. 365. Sect. 6.

neat cattle done in the vicinity of Boston. There is, therefore, no longer any reason why a source of so great pollution to the air should not be removed before another summer.

Many of the individual premises of the butchers at the abattoir, are clean and satisfactorily conducted, and some are not so, although the improvement upon the old system is very great. The Board has issued regulations, and revised regulations, but has not been able in all cases to enforce them; and, if we may judge by the experiences of other places, we cannot do so without a frequency of inspection that the present limits of the Board do not permit. Two of its members constitute a permanent committee, and a third is appointed to serve for a month at a time. This imperfect method of supervision must always be very inefficient. It, moreover, causes a heavy drain upon the time of gentlemen who are engaged in private business, and who receive no remuneration for their services.

At a meeting of the Board, held March 4, 1874, it was voted "that this Board earnestly desires that the Butchers' Slaughtering and Melting Association should, if possible, provide for more humane methods of slaughtering animals than those now used, and recommend the method practised at Providence." The abattoir committee has endeavored to accomplish this result, but has not yet been able to suggest any new way which commended itself to all parties concerned.*

It is to be urgently desired that all butchers, now and in the future, slaughtering within the Commonwealth, be required to procure licenses from the local authorities, such licenses to be at once revoked in case of gross violation of the laws, which should be made very stringent as regards cleanliness.

Some action is also recommended by this Board requiring all butchers of cattle and sheep, within the metropolitan district, to conduct their business on the premises of the Butchers' Slaughtering and Melting Association.

The Board desire also to repeat their request for the

* The *pole-axe* used in Great Britain, and the *slaughtering-mask* described in the paper in this report in "Our Meat Supply," have been sent for by the Board, and it is earnestly hoped that one of these instruments may be found to answer all requirements.

appointment of an inspector, with an adequate salary to be paid by the State, whose duty it shall be to supervise the transportation and delivery of live-stock, and to inspect animals and meat for our markets, under such limitations as may be from time to time deemed best.

"LITTLE POND," IN SOUTH BRAINTREE.

In the latter part of October, the Board received a petition from fifty-six residents in South Braintree, representing that "Little Pond," so called, is at certain seasons of the year so far drained of its water, in order to supply power to several manufactories, as to expose to the air a large portion of its bed, covered with decomposing vegetable matter, thereby causing disease and discomfort. The case was investigated, and it was ascertained that disease, and in some cases death, were probably due to this cause, but it was decided that this Board has no authority in the matter.

This is one case of many illustrating the importance of comprehensive topographical surveys of the State.

The subjects of the papers presented this year are the following:—

INEBRIATE ASYLUMS OR HOSPITALS.

By HENRY I. BOWDITCH, M. D., Chairman of the Board.

In this paper the line has been drawn between vicious and morbid drunkenness; only it must not be forgotten that the former may, if persisted in for a long time, engender actual disease, and finally become the latter.

The writer suggests a means of dealing, through inebriate asylums, with one of the most troublesome questions of the day, and we trust the community will give the matter thoughtful consideration. The success of such asylums in other places, proves their feasibility; and it is hoped that their establishment, by making our ideas of responsibility more precise in at least one point, will tend to diminish rather than increase the present unfortunate uncertainty of punishment for crime.

In proof of their estimate of the importance of this subject, the Board has passed the following resolution:—

Voted, That this Board earnestly and unanimously recommend to the legislature, as a sanitary measure of the highest importance, the establishment or endowment of one or more Inebriate Asylums or Hospitals.

THE VALUE OF HEALTH TO THE STATE.

By W. E. BOARDMAN, M. D., of Boston.

The subject of this paper has interested statisticians in Europe for some years, and it has lately received careful attention in all parts of the enlightened world. Whether all disease, or any class of diseases, can be prevented or "stamped out" or not, the experience of all countries has shown incontestably that the death-rate may be very sensibly diminished by attention to sanitary laws; and the writer has shown in this article that the State can afford to spend some millions of dollars in saving to itself the immense losses now occasioned by disease and consequent poverty in its citizens. It is but fair to say, that these estimates of loss are based upon the supposition that all persons are steadily at work except when they are sick, and that it is not possible to estimate to what degree a certain amount of disease belongs as much to the plan of nature as does death.

Nevertheless, it is clear that money judiciously spent by the State in sanatory works, is returned to it many fold in the welfare of the people.

It adds not a little to the results reached in this paper, that the estimates on which they are based have been set rather low.

ON THE TRANSPORTATION OF LIVE-STOCK.

By J. C. HOADLEY, Esq., of Lawrence, Member of the Board.

This essay will commend itself to all persons interested in cattle transportation, whether financially or from a desire that the transportation and slaughtering of animals may be attended with the least amount of suffering possible, and be conducted in a way to secure to the community the best meat. Especially may it be urged upon the notice of drovers and officers of railroads whereon cattle-trains are run. In a financial point of view, it will be well for all such persons to carefully study the facts and tables given by the author, and thereby save

themselves from loss. The subject, too, invites the attention of authorities, in view of the necessity of proper supervision by the State, in order to prevent abuse and loss.

OUR MEAT SUPPLY AND PUBLIC HEALTH.

By C. F. FOLSOM, M. D., of Boston, Secretary of the Board.

In this paper are considered the various diseases, parasitic and others, which affect the quality of butcher's meat considered as an article of food for man. The present opinions of experts in reference to other conditions in which animal food is sometimes found, and some facts bearing upon the question of its suitableness for our markets, are also shown.

Meat is divided by the writer into three classes.

First. That which is unquestionably of first-rate quality and from animals perfectly sound and healthy.

Second. That which is innutritive or lacking in the qualities which the best meat should possess; and inspection is urged for this on economic grounds.

Third. That which is positively harmful or dangerous; and in this case inspection is recommended as being necessary on sanitary grounds.

Finally. The only safe way with regard to pork is shown to consist in never eating it unless thoroughly cooked.

THE BRIGHTON ABATTOIR, ETC.

In the report from Mr. Meriam will be found interesting facts with regard to the abattoir. The daily average amount of meat used by each individual of the six hundred thousand supplied by Boston markets is estimated, from this report and from other sources, to be about eleven ounces.

Appended to this report will be found the Regulations of the Butchers' Slaughtering and Melting Association, the Revised Sanitary Regulations of the State Board of Health, an analysis of butter made from suet, and the two Acts in regard to establishing abattoirs.

ON THE COMPOSITION OF THE AIR OF THE GROUND ATMOSPHERE.

By WM. RIPLEY NICHOLS, Professor of General Chemistry in the Massachusetts Institute of Technology.

Professor Nichols has given the results of careful experiments, in order to determine the composition of the air in the soil at different places and under different conditions of temperature, season, etc. They cannot fail to be instructive and suggestive; and, at some future time, it will probably be possible to make from similar but very extensive determinations deductions of value to the health and welfare of the community.

THE VENTILATION OF RAILROAD CARS.

By THEO. W. FISHER, M. D., of Boston.

With Chemical Analyses of the Air in Cars.

By Prof. WM. RIPLEY NICHOLS, of Boston.

This subject is one which interests the greater portion of most American communities. The length of time passed by many in cars, often after a long day's work, when the system is tired and in a condition especially ready to be affected by depressing agencies, serves to render the importance of the matter by no means slight. The defects of our present system are pointed out, and suggestions are made for the application of the remedy.

CREMATION AND BURIAL; AN EXAMINATION OF THEIR RELATIVE ADVANTAGES.

By J. F. A. ADAMS, M. D., of Pittsfield.

An interesting account of the history of cremation, in ancient and in modern times, will be found here, with a very complete list of the bibliography of the subject.

The writer concludes that there exists no necessity, on sanitary or economic grounds, for any change at present in our manner of disposing of the dead.

Many facts and opinions have been collected showing the arguments for and against cremation. It is shown conclusively that cemeteries, *if managed with proper care*, may be made to conduce to the welfare of the public by affording parks

abounding in luxuriant vegetation; while their cost, as compared with that of cremation, can be a serious objection to them only in very densely-populated cities. If neglected or over-crowded, or if suffered to contaminate air or water from want of sufficient care, cemeteries may become very great evils.

At the same time, there is no real objection to cremation, excepting that which arises from religious feeling or association, and which should be respected; so that individuals should be allowed to choose in what way their own remains are to be disposed of.

REGISTRATION OF DISEASE.

The Board has attempted to carry out for the ensuing year a system of registration of prevalent diseases, which, it is thought, will be of interest and value to physicians and to the community, and which has not been attempted elsewhere. One hundred and fifteen physicians, carefully selected as being in extensive practice, have kindly consented to make weekly reports of the diseases prevalent for the week to Dr. F. W. Draper, as registrar, who suggested this plan, and who will make weekly reports to the Secretary of the Board, to be published each Thursday morning with the reports of mortality in the "Boston Journal."

HEALTH OF TOWNS.

Under this head, will be found interesting facts. We desire to call attention especially to the reports from East Boston, Salem and Woburn, as containing information of value with regard to drainage and sewerage and water-supply.

We desire to express our thanks to our correspondents in different parts of the State, who have reported to us many instructive facts, and who have entered so heartily into the work of preventing as well as curing disease.

We also thank the registrars and city clerks in the most populous places in Massachusetts, for their politeness in furnishing us the vital statistics which have enabled us to prepare our weekly reports of mortality.

The Board has felt indebted, too, to physicians and to

others interested in the public health for coöperation and assistance in many cases.

Valuable books, pamphlets, journals, etc., have been added to the small library of the Board during the year, chiefly as donations from friends. There are also many interesting papers, reports, etc., in manuscript, which could not be replaced if lost.

The Board desires to respectfully call the attention of the legislature to the fact that it has no suitable place for keeping its property, and no room for informal meetings, consultations, etc., with the hope that it will please your honorable body to make some provision in the case.

Thus far the Board has failed to expend its annual appropriation by several hundred dollars. We respectfully ask the legislature that we may be allowed to use this sum of money for the purchase of books, journals, maps, etc., to constitute a library on sanitary subjects; provided, however, that such expenditure do not exceed a total of \$500 each year.

All of which is respectfully submitted.

HENRY I. BOWDITCH.

RICHARD FROTHINGHAM.

JOHN C. HOADLEY.

DAVID L. WEBSTER.

R. T. DAVIS.

T. B. NEWHALL.

CHAS. F. FOLSOM.

EXPENSES OF THE BOARD.

Postage and stationery,	\$714 36
Personal expenses of members of the Board,	165 00
Carriages,	72 00
Printing,	372 14
Soldier messengers,	55 72
Office furniture,	33 75
Clerk hire,	229 24
Express charges,	78 25
Storage of reports,	6 00
Books and journals,	71 60
Photographs of hospitals (and postal order),	46 25
Book-binding,	10 00
Telegrams,	21 06
Boston Daily Journal, for registrars,	30 55
Salary of Secretary, <i>pro tempore</i> ,	800 00
W. Ripley Nichols, for investigations and reports,	395 00
J. M. Merrick, for analysis and report,	26 40
Expenses on report on cattle transportation,	376 26
Investigations on consumption in Massachusetts,	174 48
Paid for special investigations,—to E. Cutter,	} 802 50
J. F. A. Adams,	
W. E. Boardman,	
T. W. Fisher,	
A. H. Johnson,	
H. K. Oliver,	
H. E. Marion,	
E. D. Hamilton,	} 52 94
J. R. Chadwick,	
Miscellaneous,	52 94
	<hr/>
	\$4,533 50

INEBRIATE ASYLUMS OR HOSPITALS.

BY HENRY I. BOWDITCH, M.D.,
CHAIRMAN OF THE BOARD.

INEBRIATE ASYLUMS OR HOSPITALS.

To the Members of the Massachusetts State Board of Health.

GENTLEMEN :—A few days only before the last fatal illness of our excellent friend and co-laborer, Dr. Derby, he urged me to prepare an article on State Inebriate Asylums. I did not then agree to his proposition, but, since his death, I feel that a duty is laid upon me to carry forward any objects he had at heart. Surely, no man I have ever known devoted himself with a more self-sacrificing love or with a more intelligent zeal for a cause than he did to that which we advocate; viz., the improvement of the public health. Any proposition, therefore, made by such a man, and coming to me, as it were, from his open grave, becomes sanctified by death, and not to be refused. Were I now to decline, I should feel that I was recreant to the dying request of a well-beloved friend, and false to his noble example. Would that I could hope to prepare anything that would entirely commend itself to his mature judgment and his literary skill. As a tribute to his dear memory, I dedicate this paper, trusting that it may be of some service to the noble cause of temperance.

THE SUBJECT.

I shall not confine myself closely to the subject proposed by Dr. Derby, although that, viz., the necessity for the State to establish one or more inebriate asylums or hospitals for the cure of drunkards, will be my chief aim. As in my communications made to you on former occasions, I shall divide my present one into several parts, under different heads.

DRUNKENNESS NOW AND FORMERLY.

Drunkenness is one of the roots of all evil to the person, to his family, his friends, and finally to the State at large. It ruins the health of the individual who indulges in it. It fills our prisons with criminals who have voluntarily deprived themselves of reason before their entrance on crime. Our State almshouses are crowded with its direct or indirect victims, and they are a great burden to the tax-paying, temperate people of the Commonwealth. These statements seem truisms—I presume they will be admitted by every one. The records of the police,* of our courts and almshouses fully sustain them. The facts are lamented by all reasonable persons, even if they be temperate users of alcohol themselves. Even literature feels the influence of the avowed or silent anathemas passed at the present day upon this great curse of humanity. We find few poets who now salute in jovial strains the flowing bowl. In order to get any fervent praises of wine, we must go back to those days when to drink deeply was esteemed an honorable feat, and to lie under the table after a dinner rout was not deemed unseemly. Again, there can be no doubt of the truth of the converse proposition, viz., that society at the present hour is permeated by the temperance idea to a degree that would appear ludicrous to our fathers, when drunkenness passed with little rebuke, save from some satirist like Hogarth, of England, or Troost, of Holland, who delighted to show out boldly upon their living canvas the vices of their age. The grossest and most absurd actions were done within the memory almost of our day, and they were met usually only with a laugh, as at a mere practical and natural joke committed while in "one's cups," and therefore to be venially dealt with. No one lost caste "on 'change" or in social life by the performance of acts which would now be deemed disgraceful under similar circumstances. Exact justice, therefore, to the past and to the present times, must, I think, convince every one that drunkenness prevailed with the consent of the community to a

* From 1864 to 1873 inclusive, the yearly average of drunkards noted and recorded by the police of Boston, was as follows:—During first six years, 17,840; during last four years, 19,472. (See Report by E. H. SAVAGE, CHIEF OF POLICE, p. 57, 1873.)

much greater degree formerly than now. Almost all now despise drunkenness, many of us loathe the idea, and would consider the voluntary submission of ourselves to it as an act of the greatest self-degradation. Such being the estimates of drunkenness formerly and now, let us look a moment at our present opinion of the drunkard himself.

SENTIMENTAL REGARD FOR THE DRUNKARD.

On the threshold of this question we meet with a strange anomaly existing in this community. While no one is found to defend drunkenness, we find a very sickly sentimentalism about the drunkard on the part of some persons. Perhaps I might say that, on the part of most people, the opinion prevails that he is almost always a diseased person, and therefore is, under *all* circumstances, to be treated as an invalid, with that gentleness and forbearance which we exercise toward any other invalid. While admitting this plea of invalidism in *certain* cases, as, for example, where there is hereditary taint or under the influence of early instruction or neglect, and in certain dipsomaniacs, I deny the legitimacy of the opinion, in a majority of cases of drunken men or women.

TREATMENT OF THE DRUNKARD BY THE LAW.

A stranger anomaly still, is the fact, that while the majority of the community have these sympathetic views in regard to the drunkard, the law still holds up its terrors and declares, for example, drunkenness no excuse for crime. It tries, in its imperfect way, to keep the State from harm by means of various penalties, but it does little or nothing toward reclaiming the drunkard from his evil habits. On the contrary, the law generally, after interfering with him, leaves him worse than before. It fines him, and he goes away quite as much disposed to get drunk as he was previously. Nay, more! the public fine has degraded him; his self-respect has been seriously injured by this public censure. As a means of preventing a repetition of the offence, a fine is ludicrously inoperative. But if the man be unable to pay the fine, the matter is still worse; the culprit is then put into confinement in jail,

often with criminals, thieves, and desperadoes of all kinds.* Then and there often begins his career of real crime. Moreover, the law at this time deprives the family of the labor of the father, and virtually lets it starve, without a thought of its misery. The law, as thus administered, seems to commit a real crime against the individual, while it defeats its own best endeavor to defend the community from the evils of drunkenness. It may, I think, be summarily asserted, that it does harm to the culprit, beggars in some degree the family, and fails in its endeavor to prevent intemperance.

HITHERTO THE LAW HAS MADE NO SYSTEMATIC EFFORT TO
CURE THE DRUNKARD AS ONE DISEASED.

Thus we find that the State, by its organic laws, gives not the least assistance to the wretched victim of an all-engrossing vice. Much less does it make any attempt to cure drunkenness as a disease to which some persons are just as liable as they are to consumption or nervous diseases, typhoid fever, etc., all of which complaints are provided for by the establishment of public dispensaries, hospitals, etc.

Meanwhile a certain number of persons in the community have gone in an opposite direction, and, filled with that tenderness for the drunkard of which I have already spoken, seem to forget that his acts of drunkenness are real crimes against society. In order to prevent him from going astray, these persons would prohibit even the temperate and occasional use of any so-called intoxicating drinks. They virtually say to the small band of drunkards—"You cannot resist temptation, and, therefore, the whole community should give up its rights, and we mean to pass the strictest sumptuary laws for all of us, in order to prevent you, and a small minority like you, from going astray."

A priori, it seems singular to attempt to prevent the over-use of any article by the few, by shutting off from all persons a legitimate and non-injurious use of the same article. But, in this way, for more than twenty years, the State has endeavored to prevent intemperance among the few by prohibition to all. Moral suasion, and the early and persistent

* For excellent remarks upon this subject, see those by Mr. Savage in Police Report of Boston, page 50, *et seq.*, 1872.

inculcation of temperance, and fitting institutions for the cure of the drunkard have been, comparatively speaking, lost sight of, in the vain hope of extinguishing one of the strongest impulses implanted in the human frame; viz., a love for some stimulus, whether it be tea, coffee, tobacco, or alcohol, or some other of the numberless stimulants found on every part of the globe. Doubtless some good has been done by prohibitory laws in the rural districts, and in some, perhaps, of the larger towns; but this cannot be said of their influence in the larger cities, where the universal and open disregard of these laws, or the secret, but not less injurious evasion of them, has tended to lower in the eyes of the people their estimate generally of law. Nothing can be more fatal to the best interests of a free state than to pass any enactment whereby the keenest reverence for law on the part of the citizen is lessened.

WHAT SHOULD WE DO UNDER THE PRESENT CIRCUMSTANCES?

From the foregoing remarks it will be seen that, in my opinion, the present treatment of drunkenness and the drunkard by individual citizens and the State laws is, to use the mildest epithet, very imperfect in many respects. What more can be done in the premises? It would be very presumptuous on my part were I to claim that I can propose any measures capable of coping effectually with this enormous evil of intemperance in its blighting influence on the individual and the State. Knowing, as my profession teaches me (and modern science fully sustains the idea), the all-powerful influences of social and climatic law, of hereditary taint, and the consequent peculiarities of the individual, I cannot make this claim, but as discussion in a reasonable way is one of the chief sources of progress, I propose to make a few remarks on the following questions, viz.:

1st. What is a drunkard, and how does he stand toward the community in a free state?

2d. How shall the drunkard be treated?

If I seem to write harshly of the drunkard, it is because of the harshness of truth itself in its application to his crimes toward a long-suffering community.

The drunkard voluntarily deprives himself of his highest attribute of reason. For the time being, he makes himself a mumbling idiot, not only incapable of doing rightly a good action, but often he may be strongly inclined to do the vilest deeds toward those whom he most dearly loves, or to any stranger he may chance to meet. By putting himself in this condition he contaminates the life-blood of a free state, whose very existence depends upon her healthy and honest hard-working men and womanly women. If, then, any individual, of either sex, voluntarily resigns that manhood, or that womanhood, and makes himself, or herself, a wild beast, wallowing perhaps like a pig, in the gutter before the door; such persons should be treated humanely, it is true, but they cannot complain if they be treated *decidedly* by the sovereign state of which they claim to be members. As they voluntarily resign their reason, and thereby, for a time at least, destroy their power of acting intelligently, in their share of the public work, they surely cannot complain if their mother state sees fit to punish them, by depriving them, until they behave decently and rightly, of those very rights which they virtually discard by intemperance.

DRUNKARDS OUGHT TO BE DEPRIVED OF CIVIL RIGHTS.

I submit, therefore, that drunkards, if they be inveterate in their habits, should be deprived of all civil rights, in the same manner that the idiot, the insane, the high criminal, are deprived of their rights. I think that the law should allow any one to complain of the habitual drunkard, and on sufficient proof being given of the truth of the allegation before the proper court, said court should decree civil rights to be held in abeyance until a radical cure be effected. The best interests of the State seem to me, even in principle, not only to allow of this procedure, but to absolutely require it as a means of self-defence, if the republic is to continue in a state of purity. I believe the period will arrive when, to be drunk, even in private, will be deemed a misdemeanor, and to appear in public in a state of intoxication will justly be considered one of the greatest of crimes against the good order of the State. Any one public exhibition of this condition of mind will then be considered satisfactory evidence (unless valid

proof be procured to the contrary) of habitual drunkenness, and as such will render the offender amenable to those highest penalties which the State can inflict. For example, for one offence in public, I think that such a person should not be allowed to vote, or exercise his civil rights, for at least six months, and for a longer time on a repetition of the offence. This punishment may seem absurd to some, and be opposed by others, as wholly unjust for the amount of injury done to the State. Some earnest defenders of the rights of man will say that the error of once being intoxicated in public would not deserve so serious a deprivation as that of the right to act generally as a man in civil life. There may also be others who, from the way in which they use their own rights, will think that the deprivation of civil rights from a drunkard, will have but little force towards his cure. A man who will lie in the gutter drunk, is regardless of shame, and what cares he for civil rights? I admit this argument as of some weight as to the efficiency of the punishment, but deny the plea of its injustice. But if this plan fail, what then? Shall we have recourse to a fine, or imprisonment in a jail, as at present, or shall we, in some cases at least, treat the inveterate drunkard as a monomaniac, and place him either voluntarily, or by force of law, in an asylum, where, under moral suasion and entire removal from all external temptations, he may be able to recover his manhood,—renew, in fact, his whole character, and endeavor to be forever afterward an abstainer from every species of intoxicating drinks? That will be his sole hope of salvation. Upon these topics let us have some reasoning together.

Fines, as we have already decided, seem rarely to produce any good effects, and our jails generally prove seminaries of high learning in crime to our drunkards, and bring poverty and wretchedness to their families. All means, at times, would seem to fail of preventing drunkenness and of curing the drunkard. An early training to a manly temperance in our youth is not given; sincere moral suasion in later years is often neglected, and even prohibitory laws, acting upon the whole people, seem worse than useless in some large communities. Drunkenness prevails on all sides. The question constantly arises: What shall be done? Is there no way

open for a union of all who love temperance, so that we may escape from this vast evil? For, notwithstanding the drunkard cannot be restrained by any means heretofore used, we must nevertheless not leave him at liberty to indulge in his vile habit. We must bring him, if possible, under *his own self-control*. In order to do this, he must for a long time, months or years perhaps, be separated from the evil influences to which he has been subjected. For the total reorganization of his nature, he needs some place of refuge to which he can voluntarily retire, or in which he can be by law placed, provided he be too degraded and cannot make any voluntary effort for reformation. This naturally leads us to the discussion of the question of

INEBRIATE ASYLUMS OR HOSPITALS.—STATE INSTITUTIONS.

Massachusetts has never in its own behalf, as the guardian-mother of every one of its inhabitants, attempted to sustain an asylum or hospital for the radical cure of the drunkard. It has, it is true, sparingly aided from its funds a well-conducted "Washingtonian Home," in Boston. This institution has been in operation for the past sixteen years. Quietly, but very efficiently has it done its most noble work. It has been liberally sustained by private charity, eked out by the small fund annually granted by the State.* During the sixteen years that this institution has been in operation, one hundred and fifty-seven thousand (157,000) dollars, have been expended, or a little less than ten thousand (10,000) dollars annually for current expenses. During this period it has treated four thousand two hundred and ten (4,210) persons at a cost of about thirty-eight (38) dollars each.† It is believed that at least one-third of the number have been cured; another third have been greatly improved. One-third have not been permanently changed from their evil habits, but possibly, under increased facilities and every convenience that a great State could provide, a number of this last third might be reclaimed.

* The Washingtonian Home and its Sixteen Years of Work. Address, etc., by Otis Clapp. 1874.

† Recently the corporation has been enabled to erect a commodious building in Boston, at an expense of \$100,000. Thus the total expenditure for this corporation, since its commencement, has been \$257,000, of which only \$61,000 have been given by the State in its annual grants.

Surely, this private experiment, in one county of the State, should give encouragement to the legislature to establish other similar institutions to be sustained as works of public necessity. New York has the honor of being the first State in the civilized world that has established and wholly sustained a State Inebriate Asylum.* Maryland has recently done the same. Some other States and countries are now earnestly examining the subject.† England has had its parliamentary committee and report. It has summoned from this country experts upon the matter. Connecticut, Minnesota, and the Provinces of Nova Scotia and Ontario have also had committees on the subject. I am not aware that any movement has yet been made by the legislature of Massachusetts, looking to this desirable end. Massachusetts usually is not a laggard in any good work tending to the improvement of her citizens. I feel sure that she will not be in this instance, when once she comprehends its vast importance. As an individual, I take the ground that it is not only the bounden duty, but it is of the highest sanitary, as well as moral, importance to the State, to adopt any feasible method for more thoroughly dealing with intemperance. This vice so saps the health of individuals and of their progeny, that, as a sanitary measure, inebriate asylums could be urged upon the notice of the State with as much reason as common public hospitals were formerly demanded as public necessities.

As a matter of economy in the expenses of the State, the establishment of these hospitals might be urged. A very large proportion, now in our almshouses, are there, either directly or indirectly, in consequence of drunkenness. They are there, and virtually left to themselves. No one seems to care for them; no one endeavors to lift them up, and to raise them to a proper self-respect, and to the beauty of a life of temper-

* Fourth Annual Report of the managers of the New York Inebriate Asylum, Albany. 1874, page 5.

† The following list comprises, it is believed, all the permanently organized Inebriate Asylums in this country. Some smaller ones may exist, of which I have no information. 1. At Binghamton (New York State Asylum). 2. New York City Asylum (under Board of Charities of the city). 3. King's County Home for Inebriates, Brooklyn, N. Y. 4. Maryland Asylum, at Baltimore, Md. 5. The Sanitarium for the Treatment of Inebriates, at Media, Pa. 6. Washingtonian Home, Chicago, Ill. 7. Washingtonian Home, Boston. 8. Greenwood Asylum, under Dr. Albert Day (recently nearly destroyed by fire), at Stoneham, Mass.

ance. Consequently, they and their families are often left to regain an honorable status in society as best they may. By putting them into the hospitals I advocate, we shall not only support them, as we do now, but we shall restore a large percentage of them to the rank of honorable citizenship, and they and their families will become a part of the working force of the State, instead of being an incubus upon it, as they now are. And we shall gain these desirable ends without a much greater expenditure of funds than we now make for a comparatively futile purpose.*

Classification of Drunkards in Asylums.

Drunkards may be divided into different classes, needing different treatment. Doubtless each individual has his own peculiar character and tendencies. Hence, each drunkard should be managed so as to meet his peculiarities, in the same manner that physicians, while guided by general principles of action, have to adapt their treatment to each special case among their patients.

Among these classes of drunkards I will name the following:

Some have hereditary tendencies to the vice, and they are the most difficult of radical cure. The family taint seems at times to fairly overcome all efforts of the individual. Unless a great determination to become temperate be made by the drunkard himself, and the wisest course be pursued by the friends, such a person is doomed to spend a worse than useless life, disgraceful to himself and a source of endless sorrow to his friends. Others again seem to have periodic fits of an insane desire for drink. They will be perfectly sober and excellent men and women for several months, when suddenly, either from great sorrow, or some more trivial cause, or from helpless subjection to instinct, the liquor is seized upon to "drown care." The poor wretch then makes himself a brute for several days or weeks, until generally the stomach loathes all food; and even the liquor, previously gloated upon, becomes wholly distasteful. Not infrequently the attack terminates in that state called in common language "the horrors." Nothing

* We refer to the Appendix to this paper for ample confirmation of the propriety of establishing inebriate asylums on economical as well as moral grounds.

can be more pitiable than the condition of a human being when reduced to this dire extremity. Trembling in every muscle, his wild face is the fair index of the mind. He is no longer the drivelling idiot, but a "horror"-struck maniac, urged by terrible dreams in which, perhaps, his best friends seem acting the part of fiends, while their gentlest movements to overcome his terror appear to him brutal attacks upon his liberty or life. He trembles, and flies affrighted from imaginary demons who are pursuing him. He is in hell, even when surrounded by loving attendants, who vainly endeavor, by caresses, to soothe him in his fright. I wish I could, like the Spartans of old, introduce every young drinker into the presence of a poor wretch when in the height of a paroxysm of delirium tremens; and, if the youth did not become a temperance devotee from that moment, he would not be moved by any argument. If he could be persuaded to act as an attendant through these few days of horror, and vainly endeavor to restrain the wild delirium; if he could see the fear manifested by the victim, and watch the sudden approach of death, or the slow process of cure with entire prostration of physical and intellectual powers, the lesson would, I am sure, be a good one.

A third class, from want of an early training in a manly temperance, or from evil companionship, fall into habits of intemperance. By temperance, in this climate and country, I mean total abstinence in childhood, and only the occasional use of wine in youth, when need of body requires it, and in subsequent life, the more frequent, but still moderate, use of alcohol when health or strength call for it.

Again, it is essential, in any definition of drunkards, for the purpose of ulterior treatment in asylums, to consider the relative amount of culture and refinement, or the reverse, among the different classes. I know that we are accustomed to consider all men as equals in this country; and yet, save in God's presence, and before human law, where all have equal rights, there never was a more flagrant abuse of terms, or a greater falsehood laid down. Of all persons born into this world, no two are exactly equal, physically, intellectually, morally, or in the surroundings of their birth. These facts have immense influence on all subsequent development, from

the cradle to the grave, and they must be considered, in any arrangements to be made, in the treatment of drunkards.

Finally, the intemperate may be divided into two more classes, viz.: those who, being fully aware of their desperate condition, have made up their minds, and are anxious to use any and all means for a radical cure; 2d, another class who, though aware of their degradation, have not the moral courage to withstand temptation, or who brutally refuse to leave off drinking. Taking either of these categories of drunkards, let us see what is necessary to meet their necessities, in an asylum for their cure.

I think arrangements could be made in inebriate asylums, as at all hospitals, for private apartments and public wards. Out-of-door arrangements, such as farm work, and work in mechanic shops, or the more quiet pleasures of intellectual pursuits, are likewise called for.

It seems to me that at least one asylum should be forthwith erected, or adequately endowed, by this State. Eventually, when the ideas connected with such a building become more thoroughly digested by the people, we shall need more, in order to classify the inmates; certainly, so far as to partially, or perhaps wholly, separate those who voluntarily seek the asylum from others who are compelled to go there by law. I think, still further, that it would be advisable to allow those able to pay for larger and more commodious apartments, and fuller attendance, to do so, in the same way as the McLean Asylum provides the "Appleton Ward." In this way we could give a more home-like feeling to some persons than can possibly be obtained in a large ward. I should hope, however, that in every asylum there would be an opportunity for all to meet on a common ground of the lecture room, the church, the library, and reading-room. I should wish for this amount of intercourse, because I would have the asylum, as much as possible, like the world at large, save in one particular, viz., there should be such a total abstinence from liquor as would gladden the heart of the warmest friend of prohibition. I would scarcely ever use alcohol in any form, even medicinally, and as a lotion, and never (if possible to avoid it with safety to human life) should it be taken internally, within the walls of an inebriate asylum.

Sites for the Asylum.

They should be in the interior of the State, in a fertile spot, where farming would be possible and easy. They should be removed from the noises and temptations of the city, but easy of access by rail. The grounds should be extensive, and well laid out in roads, bridle, and foot paths. They should have woods near or upon them. The sites should be, if possible, among the most beautiful and healthful in the State; they should command extensive views, so that the first sight that would greet the eyes of the inmates, with every morning light, should be such as to excite pleasant and grateful thoughts. The houses should be commodious, of medium size, and not expensively or luxuriously built. They should be airy, and bathed in sunlight all day long; ample space should be afforded by them for walking and exercise in all weathers, by means of piazzas, or covered corridors, carriages, etc. These sites should be recommended, as by law now provided that all sites for public institutions should be, by the State Board of Health, with especial reference to the various sanitary conditions best fitted for mind and body. In a word, I would have every arrangement in and outside of the houses so made as to produce cheerfulness and brightness. A tranquilizing, but not sad, influence should permeate and surround the whole.

Employments of the Inmates.

A large farm should be connected with each institution. This should be under the direction of an experienced farmer, who should ask the services of volunteers, or should require of non-paying inmates, whether voluntary ones or those put there by law, a certain number of hours of work each day. This work would be beneficial to the worker, and while it would produce a certain amount of the food for the establishment, it would also aid in the proper discipline of the inmates. Immediately around the house should be planted flower-beds, similar to those seen everywhere in England, which, kept in order by the inmates, would contribute much to the pleasure and healthful activity, if not actual profit, connected with the house.

Work-Shops.

Work-shops, in which carpentering, joining, painting of all kinds, and turning in iron and wood, could be carried on, should be in constant operation. They should be the general repair-shops for the institution. Of course, skilled workmen should superintend; but the object being to afford interesting work to inmates, all should be urged to avail themselves of the privilege of more or less active work therein afforded. Those who by law may be confined should be required to labor, and might be taught some useful trade, which would help support them on leaving the asylum. Amongst others, I should hope the printer's trade would not be neglected. A journal, published by the patients, would be one of the most effective means of pleasure and improvement for all.

Amusements.

There should be amusements of every kind; billiard rooms; bowling alleys should be open; base ball, cricket, foot ball, and croquet should be encouraged by the superintendent. The superintendent and his wife should likewise be persons capable of preparing evening entertainments, charades, whist-parties, readings, recitations, lectures and concerts. Occasional private conferences of the patients might be held, at which personal experiences might be told, in full confidence of the entire sympathy of all present; to these no outsider should ordinarily be admitted. Many a word of encouragement and of abounding hope might be given at these friendly meetings by those who have been through the "slough of despond," and may have overcome all difficulties. Some poor soul, still struggling with the trials attendant on a weak nature, and while staggering almost in despair of ever reaching any sure foot-hold, from which to begin anew the work of life, would gain at such meetings the requisite courage and strength. If possible, I would have a band of music from among the residents, led by an experienced music-teacher. An adult school should be open daily for the instruction of those ignorant of the common rudiments of learning. Assistants in this school, as teachers, I should expect would be sometimes found among the patients. A wise superintendent

would gently but earnestly urge this duty of teaching upon those of the inmates who have better cultivated minds, placing it upon the high ground of mutual benefit, to the teacher and taught ; for surely no employment tends more to develop the intellect and all manly qualities, than self-forgetful instruction given to those less wise than ourselves. The name of teacher, Agassiz considered the highest title he could assume.

Superintendent.

This man should be of a large and high-toned nature. He must be able to look upon all the inmates, however degraded they may be at entrance, as fellow-mortals, born under the same laws as those which brought himself into existence, and therefore his own self-respect should lead him to treat those committed to his charge with respect as well as with authority. He should do all his work under a solemn sense of responsibility to God and to man ; he should be no bigot of a sect. He should not try to proselyte to certain dogmas of belief, but to gently lead all to temperance. His object should be to induce all under him to act up to that inner light that dwelleth in every human being, and which tells him that an honest, true and temperate life is the only one worth pursuing. He should have a finely-cultivated intellect, and he should be in perfect health of body, otherwise his important duties would be likely to suffer.

Dyspepsia, or debility of mind or body, are always antagonistic to authority and to a true estimate of life in others. His presence should be a benediction as well as a power.

Such a man would have equal laws, but no tyranny. His word, having been once declared, under the best light he can get, would govern all with justice and mercy. No common man *could* take the place. He should be selected by trustees appointed by the governor and council, and be removable at the pleasure of the trustees, under whom he would act. We have very few in the community capable of taking the place ; there are doubtless many persons who would seek the place for the salary, and for the gratification of a petty, though perfect, authority the office would confer.

If possible, a man who has had experience should be first selected, and his deputy, chosen or nominated by himself,

should be gradually initiated into all proper methods of conducting the establishment. The whole should be under the general direction of some non-political body of trustees, appointed by the executive of the State. Believing that the treatment of intemperance is one of the greatest subjects this Board can consider, and looking to the far future, rather than to the present, I think that the duty of superintending these establishments, and of nominating the proper persons to be resident superintendents, might, with propriety, be vested in the State Board of Health. I hold this opinion upon these, among other reasons, that might be adduced for this suggestion, viz.: First: that in the original Act establishing this Board, the legislature ordered the Board from time to time to report upon the uses of alcoholic liquors by the community, and for the prevention of intemperance; and second: because by the same act the Board was directed to advise with the government on the selection of sites for public institutions; and third: because by its constitution the Board will generally be removed from party politics and partisanship.

Attendants.

These should all be selected with especial reference to the moral rather than the physical objects of the place, and no one should ever be appointed to fill any place who was not fully alive to the high objects proposed, and hopeful of good from the general work of the institution.

As great care should be used in the selection of these persons as is now taken in the choice of attendants in hospitals for the insane. The superintendent should nominate them to the trustees, and should be held strictly responsible for their good behavior.

Religious Instruction and Worship in the Place.

I would have services at certain periods, conducted by clergymen of the various denominations, or by laymen. No dogmas should be preached, but the sole object should be to lead the inmates to a proper self-respect, by raising in each a lively sense of his own responsibility to God and to mankind for the proper care of his own body, by living a temperate life; even this latter point should be rather indi-

rectly than directly advocated. For I would not willingly offend by a religious act the self-esteem of a patient in the asylum. No one should be obliged to attend these services, and no one, for non-attendance, should suffer in the estimation of any one or have different treatment in consequence of such absence.

PENAL ASYLUMS.

In all I have thus far suggested, I have supposed an institution in which the inmates have rather a voluntary than a forced residence. It may be asked, how I would manage those incorrigible, brutal drunkards, who go to the place from no will of their own, but simply when forced to do so by the arm of the law. It is evident that, at first, it will be necessary to use more restraint, but even with these poor wretches I hope that an able and skilful superintendent would soon be able to relax all penal arrangements. Especially could this be done if the court, when sending the victim to the asylum, should let him distinctly understand that if he attempt to escape, without permission, or behave in a manner unbecoming the institution, he will be summarily sent to a house of correction, or otherwise more severely treated.

ASYLUM ACCOMMODATIONS FOR WOMEN.

In my preceding remarks I have, while considering chiefly asylums for men, made many suggestions that are equally applicable to institutions, or parts of institutions, which would be devoted to the treatment of females. Of course the superintendent of a female institution or department of a general asylum should be a woman. Some modifications of employments would likewise be necessary, but the general principles of treatment of the male and female drunkard would be identical.

REPORTS.

Annual reports to the legislature should be made by the trustees early in the legislative year, with statements of finances, and of all other points of interest naturally connected with such an institution.

CONCLUSION.

I have thus, gentlemen, given you my sincere convictions of what the State ought to do in one direction, at least, toward stemming this frightful evil of intemperance, which, although perhaps less diffused than formerly, and certainly not permitted by society as it was formerly, is nevertheless an evil of the greatest magnitude in Massachusetts. I sincerely hope that the Board will unite with me in advising the legislature to enter upon this plan of reformation. The idea, I trust, will also commend itself to all citizens. No one, even if he be a temperate or intemperate user of liquor or a strictly total abstainer, can object to this, which has been proved to be a feasible plan for curing the real drunkard.

Finally, I would suggest for your consideration the following resolution :—

Voted, That this Board earnestly and unanimously recommend to the legislature, as a sanitary measure of the highest importance, the establishment or endowment of one or more inebriate asylums or hospitals.

I remain, very faithfully,

Your friend and colleague,

HENRY I. BOWDITCH.

APPENDIX

TO THE PAPER ON INEBRIATE ASYLUMS.

INTemperance as a Cause of Pauperism.

In December last, circulars from the Secretary of the State Board of Health were sent to the overseers of the poor of this Commonwealth, requesting answers to the following questions, and any other information on the subject involved in them, in order to complete investigations being made by the Chairman of the Board, Dr. Henry I. Bowditch.

1. What proportion of the inmates of your almshouse are there in consequence of the deleterious use of intoxicating liquors?
2. What proportion of the children in the house are there in consequence of the drunkenness of parents?

The number of cities and towns in the State is 341, and replies have been received from 282.

First Question.

Fifty towns are without almshouses, supporting their poor in those of other towns, or in private families. Eighty towns report none of this class as inmates. The following are the results derived from the reports of the remainder.

Adult inmates directly and indirectly from this cause. Results from fifty-one towns.

[illegible]

Proportion reported by these fifty-one towns.

Highest,										$\frac{15}{17}$
Lowest,										$\frac{2}{31}$
1 town,	$\frac{15}{17}$	5 towns,								$\frac{1}{4}$
1 "	$\frac{6}{7}$	3 "								$\frac{2}{7}$
3 towns,	$\frac{2}{3}$	2 "								$\frac{1}{5}$
1 town,	$\frac{3}{4}$	1 town,								$\frac{3}{16}$
1 "	$\frac{9}{14}$	2 towns,								$\frac{1}{6}$
1 "	$\frac{13}{23}$	2 "								$\frac{1}{7}$
8 towns,	$\frac{1}{2}$	2 "								$\frac{1}{3}$
1 town,	$\frac{5}{8}$	2 "								$\frac{1}{9}$
1 "	$\frac{4}{7}$	2 "								$\frac{1}{10}$
1 "	$\frac{5}{9}$	1 town,								$\frac{2}{11}$
1 "	$\frac{4}{9}$	1 "								$\frac{2}{20}$
6 towns,	$\frac{1}{3}$	1 "								$\frac{3}{31}$
1 town,	$\frac{5}{17}$									

Average percentage of adults from this cause, 35+.

Almshouses having only adult inmates, and reporting only the proportion from this cause. Thirty-five towns:

Highest,										$\frac{19}{20}$
Lowest,										$\frac{1}{7}$
1 town,	$\frac{19}{20}$	5 towns,								$\frac{1}{2}$
1 "	$\frac{9}{10}$	5 "								$\frac{1}{4}$
2 towns,	$\frac{3}{4}$	1 town,								$\frac{2}{5}$
3 "	$\frac{2}{3}$	4 towns,								$\frac{1}{5}$
2 "	$\frac{5}{8}$	1 town,								$\frac{1}{6}$
5 "	$\frac{1}{2}$	2 towns,								$\frac{2}{7}$
1 town,	$\frac{4}{7}$	2 "								$\frac{1}{7}$

Average percentage from this cause, 40+.

Reports from almshouses of fifty-seven towns, giving only the proportion, from this cause, of all inmates, both adults and children.

Highest,										$\frac{49}{53} = 92$ per cent.
Lowest,										$\frac{1}{23} = 4.8$ per cent.
1 town,	$\frac{49}{53}$	10 towns,								$\frac{1}{4}$
1 "	$\frac{9}{7}$	1 town,								$\frac{5}{16}$
2 towns,	$\frac{7}{5}$	1 "								$\frac{2}{5}$
1 town,	$\frac{8}{9}$	1 "								$\frac{2}{3}$
5 towns,	$\frac{3}{4}$	1 "								$\frac{2}{9}$
5 "	$\frac{2}{3}$	4 towns,								$\frac{1}{5}$
1 town,	$\frac{7}{11}$	1 town,								$\frac{1}{6}$
1 "	$\frac{9}{14}$	6 towns,								$\frac{1}{8}$
4 towns,	$\frac{1}{2}$	1 town,								$\frac{1}{9}$
1 town,	$\frac{23}{45}$	1 "								$\frac{3}{13}$
2 towns,	$\frac{4}{5}$	1 "								$\frac{1}{11}$
3 "	$\frac{1}{3}$	1 "								$\frac{1}{1}$
1 town,	$\frac{11}{38}$									

Average percentage, 41.

Answers not proportional.

9 towns report "one."	1 town reports "all, i. e. one."
3 " " "two."	1 " " "all, i. e. two."
1 " " "five."	1 " " "all."
1 " " "probably ten."	

Seventeen towns. Number reported by sixteen towns,—33.

Second Question.

90 towns report,	No children in house.
86 " " " " " " " " " " " "	"None" from this cause.
27 " " " " " " " " " " " "	"All" " " " "

Thirty-three towns report one hundred and forty-five such children.

From drunkenness of parents,	105
" " " both parents,	23
" " " father,	17
Total,	145

Proportional Answers.

Fourteen towns. Highest, $\frac{40}{100} = 98$ per cent. Lowest, $\frac{1}{3} = 33$ per cent.

1 town, $\frac{40}{100}$	3 towns, $\frac{3}{4}$
1 " $\frac{13}{4}$	1 town, $\frac{1}{5}$
1 " $\frac{9}{10}$	1 " $\frac{1}{2}$
1 " $\frac{9}{11}$	1 " $\frac{4}{7}$
1 " $\frac{7}{8}$	1 " $\frac{2}{5}$
1 " $\frac{6}{7}$	1 " $\frac{1}{3}$

Average percentage, 72.9.

TOWNS HAVING NO ALMSHOUSES.

First Question.

Proportional answers, five towns. Highest, $\frac{1}{2} = 50$ per cent. Lowest, $\frac{1}{6} = 16.7$ per cent.

2 towns, $\frac{1}{2}$	1 town, $\frac{1}{5}$
1 town, $\frac{3}{4}$	1 " $\frac{1}{6}$

Average percentage, 35.8.

One town reports as supporting no children, and proportion as $\frac{2}{5} = 40$ per cent.

Eight towns report twenty adults, viz.:

3 towns, "one"	3	1 town, "five"	5
3 " "two"	6	1 " "six"	6

20

One town "all," one town nearly "all." One town as lodging and feeding ten "tramps," or vagrants, per diem.

Second Question.

Proportional answers, three towns. One town $\frac{7}{8}$; two towns $\frac{1}{2}$; average 62.5 per cent.

Nine towns report thirty-five children, viz.:

2 towns, 3,	.	.	.	.	6	1 town, 1,	.	.	.	.	1
1 town, 10,	.	.	.	.	10	1 " 6, "all"	.	.	.	.	6
2 towns, 2,	.	.	.	.	4	1 " 5,	.	.	.	.	5
1 town, 3,	.	.	.	.	3						—
											35

One town "all." One town "none."

Outside Aid.

By towns having almshouses

First Question.

Proportional answers, including adults and children. Six towns

1 town, .	.	.	.	.	$\frac{9}{10}$	1 town, .	.	.	.	.	$\frac{1}{2}$
1 " .	.	.	.	.	$\frac{4}{5}$	1 " .	.	.	.	.	$\frac{5.5}{14.9}$
1 " .	.	.	.	.	$\frac{3}{4}$	1 " .	.	.	.	.	$\frac{2.50}{25.8}$

Average percentage, 71.4.

1 town reports, . . . 5 parents | 1 town reports, . . . 3 persons

Second Question.

Proportional answers. Four towns.

1 town, .	.	.	.	.	$\frac{9}{10}$	1 town, .	.	.	.	.	$\frac{1}{2}$
1 " .	.	.	.	.	$\frac{3}{4}$	1 " .	.	.	.	.	$\frac{2.7}{8.5}$

Average percentage, 61.6.

1 town reports,	.	.	.	.	.	.	.	.	.	4 child.en.
1 " "	.	.	.	.	.	.	.	.	.	12 "
1 " "	.	.	.	.	.	.	.	.	.	6 "
Total,	.	.	.	.	.	.	.	.	.	22 "

Particular Answers by Towns.

Bernardston.—No. 1. One-fourth of the number and nearly half the expense chargeable to whiskey.

Boston.—Nos. 1 and 2. Deer Island Almshouse and Hospital. I would answer the above (the two questions) by saying to the best of my knowledge and belief per 90 cent. to both questions.

Our register shows that full one-third of the inmates received for the last two years are here through the direct cause of drunkenness. Very few inmates (there are exceptions) in this house but what rum brought them there. Setting aside the sentenced boys (sent here for truancy, petty theft, etc.), nine-tenths of the remainder are here through the influence of the use of intoxicating liquors by the parents. The great and almost the only cause for so much poverty and distress in the city can be traced to the use of intoxicating drink either by husband or wife, or both.

Chelsea.—No. 1. We have no almshouse, but are of opinion that fully one-half of those we aid as paupers become so by reason of using intoxicating liquors as a beverage.

No. 2. The same answer can be given to this question.

Chesterfield.—No. 1. Seven-eighths of all the inmates of our almshouse are there in consequence of the deleterious use of intoxicating liquors, directly or indirectly.

No. 2. There is but one child that cannot be traced to intoxicating liquors.

Chicopee.—No. 1. Nineteen out of twenty. If it were not for intoxicating liquors, we should not need any almshouse.

No. 2. Forty-nine out of fifty.

Danvers.—No. 1. We have no almshouse in Danvers. Our poor are mostly supported in private families. About one-sixth of our poor are made paupers by intoxicating liquors.

No. 2. One-half of our children are a town charge in consequence of the drunkenness of their parents.

Dedham.—No. 1. We have fifteen in our almshouse, and *three-fourths* of the whole *at least* are there in consequence of the use, by themselves, or others on whom they should have depended for support.

No. 2. The same proportion will apply to all the children, and I think more. The same rule will hold good to all the poor *outside* the almshouse, and leave a margin, I fear.

Fairhaven.—No. 1. All are directly or indirectly there on account of the use of intoxicating liquors.

Gardner.—No. 1. Nearly one-half.

No. 2.—Whole number that we have had at our almshouse.

Gloucester.—No. 1. We have had in our almshouse this year forty-six inmates,—thirty-two adults and fourteen children. Twenty-six of the adults were there in consequence of the use of intoxicating liquors.

No. 2. All the children, fourteen in number, that are there and have been there for 1874, were there in consequence of drunken parents.

Out of about two hundred applicants for outside relief during the year, fifty per cent. of them were made poor directly or indirectly by the use of intoxicating liquor.

Hancock.—No. 1. There has been no public sale of liquors in Hancock for several years, and we therefore have no paupers and no almshouse.

Haverhill.—No. 1. We have had fifty-three at our almshouse the past year; forty-nine are there directly and indirectly from intoxicating liquors. Thirty-two directly and four from other causes besides liquors.

No. 2. We have had eight families at our almshouse with children, seven on account of intemperance, one from other causes. Twelve children out of fifteen are there from drunken parents, both father and mother.

Huntington.—No. 1. We have no almshouse, but we have to aid some every year whose poverty is partly or wholly chargeable to intemperance. We have three persons who are partly chargeable to intemperance now.

No. 2. Two of the three above named are children. We have but five who are wholly chargeable now.

Number of persons, in 1873, who pay a poll-tax only, is ninety-one. Number in 1874 is eighty-five.

Lexington.—No. 1. There are seven adults in the house, four in consequence of intemperance.

No. 2. There is but one child in the house, and that one is owing to the intemperance of both parents.

We are furnishing aid to five parents and twelve children outside of house, intoxication being the cause.

Ludlow.—No. 1. Hospitals, almshouses, prisons, we have none.

Lynnfield.—In my experience as an overseer of poor for more than twenty years, I find a large percentage of those brought to the necessity of help from the town to have been caused by the use of intoxicating liquors. I am also happy to add, that in the country towns, the children of those parents who have been so unfortunate as to need such assistance, through the influence of our schools and the changes in the customs of society, are being educated up to a moral standard which promises a better future and less pauperism.

Methuen.—No. 1. There are now in the almshouse in this town thirteen inmates. Nine belong to one family, which is there temporarily in consequence of the drunkenness of the father. The remaining inmates (four) are not there in consequence of the deleterious use of liquors.

No. 2. All.

In my five years' experience as overseer of the poor, I should not estimate the number of paupers fully supported by the town of Methuen, who became so by the excessive use of intoxicating liquors, as more than one-fourth.

Milford.—Nos. 1 and 2. At this date (Dec. 14, 1874), there are in our poor-house nine men, eight women, and eight children. Of the nine men, seven are habitual drunkards, two made paupers by drunken sons, who have spent the property of their fathers, and made them paupers. Of the eight women, one is a drunkard, four others had drunken husbands, one a drunken father, the other two we cannot find out, not being able to get their parentage. Of the eight children, four have drunken father and mother, two drunken fathers; the other two have temperate parents. Of the two hundred and fifty-eight persons partially aided Sept. 1, 1874, we can find but eight persons who do not owe their poverty directly or indirectly to the use of intoxicating liquors.

Milbury.—No. 1. Three-fourths of them.

No. 2. We have no children at almshouse at present, but all that we have had in the past, to my knowledge, have been on account of drunkenness.

Monroe.—We have no almshouse in town and no drunken inmates. No paupers in town that I know of.

Montgomery.—We have no almshouse in the town of Montgomery, but three-sevenths of our paupers were made so from liquors.

New Ashford.—This town has but one pauper at present, seventy-six years of age; he has been a drunkard for more than fifty years; his son is a drunkard, and his grandson is ditto.

Newbury.—We have no almshouse, but those that are partially supported, and about one-half of the fully supported, are all caused by intoxicating liquors.

Norfolk.—Fortunate for our town, we have no almshouse, nor house where liquor may be obtained, but will give this testimony: have never examined any case of pauperism as to its cause but found drunkenness as a family disease.

Pittsfield.—No. 1. About one-half.

No. 2. We have no children in our almshouse except from drunken parents.

Raynham.—No. 1. The only two *fully* supported by the town, and one-third of those partially supported.

Richmond.—No almshouse, no town paupers for the last three years. We have from one to ten vagrants or “tramps” each night, and many of them show the effect of liquor.

Rowley.—I have been overseer of poor thirteen years, and think six-eighths of our pauper expense is caused by liquor, directly or indirectly.

Russell.—No. 1. There is no almshouse in Russell, but most of those supported become paupers on account of liquor.

No. 2. Three-fourths.

I believe that tobacco in all its forms has more to do in making men intemperate and drunkards than any other cause. Drinking generally follows the using of tobacco. Boys commence young in using it, and drinking soon follows.

Sandwich.—Of one hundred and forty-nine persons aided out of almshouse (sixty-four adults and eighty-five children), fifty-five are paupers from intemperance (twenty-eight children and twenty-seven adults). Not all the adults were themselves intemperate, being widows and wives whose husbands are or were drunkards.

Springfield.—No. 1. There are thirty-one adults in our almshouse, and twenty-one were brought there by intemperance.

No. 2. There are fourteen children, and thirteen in consequence of drunkenness.

In addition to circular, I would say that we have lodged and fed eight thousand and fifty-two persons that we call “tramps,” and I can seldom find a man among them who was not reduced to that condition by intemperance. It is safe to say nine-tenths are drunkards, though we have not the exact records; also our records show that we have aided outside the almshouse four hundred families, one thousand one hundred and twelve persons, out of which one hundred and twenty-five families, four hundred and forty-three persons, were brought to destitution by intemperance.

Stockbridge.—No. 1. We have no almshouse, but one-fifth of our paupers are supported because of such use.

Stoughton.—No. 2. None just now, but during the past year one hundred per cent.

Wakefield.—We have at the present time fourteen inmates of our almshouse. Of these, nine were brought there directly by the use of intoxicating

liquors. Of the remaining five, three were so weak mentally as to be incapable of supporting themselves, but whose condition was aggravated by the use of spirituous liquors. In short, of the whole fourteen, there are but two entirely free in this respect, while nine of the number were reduced to their present condition by this pernicious habit.

Wales.—We have no almshouse, but we have one pauper that has been supported by our town over forty years in consequence of the intemperance of her husband; and a son of these parties is supported at the Northampton Hospital for the Insane, brought to his present condition on account of his own and his father's intemperate habits. We have supported him about fourteen years.

Westfield.—No. 1. There are two aged men, both in consequence of intoxicating liquors; seven women; four of the husbands died drunkards.

No. 2. Three idiotic boys; their fathers are drinking men.

West Newbury.—No. 1. One-eighth part of the inmates of our almshouse for the past year were there in consequence of excessive use of intoxicating liquor, and that part indirectly.

Winchester.—Am sorry to say that, of all that receive aid from this town, four-fifths are themselves addicted to the over-indulgence of intoxicating drink, or are the families of such. Of the seven that receive full support from the town, three are confirmed inebriates, one widow of an inebriate, two are children of a drunken father, and one from disability not caused by drink.

Winthrop.—We have no poor.

Worcester.—No. 1. From October 1st, 1873, to October 1st, 1874, there were in our almshouse ninety persons in all, and forty-six of them were sent there from the effects of intemperance.

No. 2. We have in our almshouse seven children, all of whom are there from the cause of drunken parents.

Think can safely say from records of overseers of the poor, that fully forty per cent. of the disbursements of the almoner of the board have gone to sustain drunken families. We have about fifty thousand inhabitants, and near fifteen thousand are foreigners, mostly Irish and Canadians.

State Institutions.

South Boston (School for Idiotic and Feeble-minded Youth).—No. 1. Probably one-third in consequence of the indirect effect of the habitual use of strong drink.

No. 2. The parent or parents of one-sixth are avowedly drunkards. The real proportion is much higher—I should say one quarter.

Bridgewater (State Workhouse).—No 1. Two-thirds.

No. 2. One-third.

Charlestown (State Prison).—No. 1. About eighty five per cent.

Lancaster (Industrial School).—No. 1. About five per cent.

No. 2. About seventy-five per cent.

Northampton (State Lunatic Hospital).—No. 1. Patients admitted from December 30th, 1873, to October 1st, 1874 (one year): men, one hundred and five; women, eighty-eight; total, one hundred and ninety-three. Intemperance alleged as the cause of insanity: men, twenty-one; women, three; total, twenty-four. Of at least one-half of our patients we obtain no full and reliable history. I think it would be fair to assume intemperance as the main cause in at least twenty-four cases more.

Taunton (State Lunatic Asylum).—No. 1. Without going into close calculation I should say, one-fifth; certainly as many as that if you include those where the use of intoxicating liquors is conjoined with other causes as hereditary predisposition, trouble, etc.

Tewksbury (State Almshouse).—No. 1. Our physician says three-fourths.

No. 2. Don't keep any record by which we can ascertain.

Westborough (State Reform School).—No. 1. Two-sevenths.

No. 2. One-half plus.

Worcester (State Lunatic Hospital).—No. 1. Five per cent. are attributed to intemperance, and in a few other cases intemperance doubtless was one of the causes. Of eight hundred and seven patients admitted during the last two years, just ten per cent. were caused by intemperance, and in a few others intemperance may have aided.

STATE WORKHOUSE, BRIDGEWATER, Dec. 14, 1874.

CHAS. F. FOLSOM, M. D., *Secretary of State Board of Health.*

DEAR SIR:—Your circular is just received. My answer to your questions must of necessity partake largely of "guesswork." The prisoners at this institution are rather of the mild type of criminals. Most of them sentenced on such charges as the following, viz.: "Idle and disorderly," "Vagrant," "Common drunkard," "Lewd, wanton, and lascivious." The first class, "Idle and disorderly," comprise I think two-thirds of the whole. The children that are here, sixty in number, are mostly illegitimate—were born here of mothers who were sentenced for being "lewd." From information received of the inmates themselves, I should say seven-eighths of the adults were in the habit of using liquor to excess.

I have answered your questions somewhat at random, but think I am not much out of the way.

Yours truly,

N. LEONARD, Jr., *Supt.*

THE VALUE OF HEALTH TO THE STATE.

By W. E. BOARDMAN, M. D.

(OF BOSTON).



THE VALUE OF HEALTH TO THE STATE.

In general terms, health is defined as that condition which results from the harmonious relations and painless operations of the organic functions of the human system, and enables us readily to accomplish the ends of life. Disease, too, is a product of organic functions, but of those whose harmony of relation and insensible operations are interfered with. Health and disease, like the conditions implied by the terms strength and weakness, are not simple entities, but they are exceedingly complex, variously derived, comparative conditions. No one is absolutely well, nor is any one diseased in all respects, but every one is more or less healthy or diseased. Our estimate of the degree of health or sickness is founded upon the extent to which our capabilities for performing the ordinary duties of life, during our natural existence, are interfered with.

Since, then, the value of a life depends upon its accomplishments, and these again upon its capabilities, the value of health to the individual is self-evident. It is a fact, however, which ought to be understood and appreciated by every one, that it is not alone from his own good health that the individual derives benefit, for the well-being of his neighbors and associates, likewise, is the source of many, and oftentimes of far greater advantages to himself.

Public health is merely the general term for the health of large aggregations of persons, as distinguished from that of the individuals; but, at the same time, it is the expression of the totality of the individual conditions. If we apply, then, the same reasoning in our estimation of the value of a corporate body, an analogy which cannot be disputed, it appears

that the prosperity of a town, city, state or country stands in immediate relation with its sanitary condition. It is obvious, therefore, that there exists a community of interest between the individual and the State of which he forms a part; and, while the latter is required zealously to watch over all the conditions of the health of its members, as the basis of its corporate prosperity, the individual ought always to seek the promotion of the well-being of himself and neighbors, as an essential condition of his own welfare.

This mutual relation, in respect of health, between the individual and community was recognized, more or less, even in the remotest ages, a fact which is attested by the fables of mythology, by history, both sacred and profane, and, above all, by the impressive stories which are told by the ruins of Babylon, Jerusalem, and ancient cities of Greece, Egypt, and Italy, wherein are found monumental works which rival the products of modern sanitary engineering, and point to the fact, that those nations which attained the highest civilization and wielded the greatest influence over their contemporaries always exercised a careful guard over their health. In succeeding ages, when civilization declined and the unwritten period of barbarism was inaugurated, all hygienic laws were put to defiance in the general destruction which prevailed; and the sanitary lessons of previous ages were lost, to be recalled in a measure only, in the subsequent middle ages, when terrible epidemics cut off one-fourth of the population of Europe, and, again, more forcibly, in the following centuries of luxury and squalor. In later years, when civilization has made such great advances, crude hygiene has developed into the more comprehensive study of the laws of disease as they affect large masses of human beings. Innumerable expedients have been adopted for the amelioration of disease and the improvement of health. The greatest minds have been devoted to the investigation of the origin of diseases, and inventive genius has been stimulated to the utmost. Yet, to-day, we can hardly do more than did the ancients; namely, endeavor to keep clean, or, following the counsel of the wise Hippocrates, provide for pure air, pure water, and a pure soil.

While, therefore, to-day, as in all ages, the problem of health finds its solution, in a great measure, in the observ-

ance of simple cleanliness, it is in the benefits which are derived from the more general application of this principle, that we observe the results of modern thought and resources, of recent improvements in the means of communication, and of the more general intercourse which prevails.

Humanity alone, which finds its expression in the Christian law, "Thou shalt love thy neighbor as thyself," is and ought to be a most potent influence in favor of the promotion of the public health; but, in its practical application to communities, sanitary science comes into constant contact with personal convenience, avarice, mistaken economy, long-established customs and habits and an erroneous judgment of the future by the favorable condition of the present and the past. Hence has arisen the necessity of educating the people up to the point of recognizing the community of interest which exists between the individual and the State, and which cannot be promoted except by the general supervision of competent authorities invested with proper powers.

As a contribution to this education of the public, this paper has been prepared, with the view of showing that, in promoting measures for sanitary improvement, a town, city or state, and the like, practises true economy, nay more, creates and invests a capital which will return a high rate of interest.

It is the good fortune of many persons that they do not lose a single day in the year from sickness, while others lose weeks, months, and many the entire year. It has been truly said that it is hard to find a family in which every member is well. There is, at least, one invalid in nearly every household.

The general registration of sickness has not yet been attempted, though the value of such a course has repeatedly been urged of late. Statisticians, however, have furnished us with reasonable estimates for calculating the sickness-rate. They have shown that in Europe, every individual loses, on an average, nineteen to twenty days annually by sickness. English statisticians have estimated that, in that country, for every death there are two constantly sick; in other words, that every death implies a total average of 730 days of sickness.¹

The unfortunate experience of the health assurance com-

¹ Report of the Massachusetts State Board of Health, 1873, p. 346.

panies in this country demonstrated the fact that the amount of sickness or disability is greater here than it is in Great Britain, as was shown by Dr. Edward Jarvis in the paper contributed by him to the Report of this Board for the previous year. We may safely assume, therefore, the English sickness-rate in the following calculations for the State of Massachusetts.

In the Registration Report for 1872, a computation is made showing the mortality of the State, in six geographical divisions. In the first or metropolitan district, comprising the city of Boston, the rate of mortality was the highest. There were 8,088 deaths in a population of 250,526. Calculating 730 days sickness for each death, it appears that, during the year, each individual lost, on the average, nearly 24 days. In the sixth or western district, including Berkshire County, where the rate of mortality was the lowest, there were 1,234 deaths in a population of 64,827, which would represent an annual loss to each person of only about 14 days by sickness. In the whole State, during the same year, there were recorded 35,019 deaths, while the population was estimated at 1,541,542, which would give a total loss of 70,038 years; or nearly 17 days for each individual in the State. Computing in the same way for the State for eight years, from 1865 to 1872, inclusive, the following results are obtained. The average population was 1,400,522, and the average annual mortality was 26,813. There was an annual loss, therefore, of 19,573,490 days by sickness, 13.9 or about 14 days for each person; considerably less than obtains in Europe.

The correctness of the assumed sickness-rate, which is the basis of the preceding calculations, may be roughly demonstrated in the following manner. Since the opening of the Boston City Hospital, according to the annual report for the year 1873, there have been 22,927 patients admitted for treatment, of which number 1,917 have died, or about 1 in 12. In the Massachusetts General Hospital, a similar ratio prevails, and the same is true of all the state institutions, calculating only for those inmates who are classed as patients. During the year 1872, out of 36,053 patients admitted to the various hospitals of New York city, 3,274 died, or about 1

in 11. From the sixth report of the medical officer of the privy council, it appears that of 31,605 medical patients admitted to various hospitals of Great Britain and Ireland, about 11 per cent., or 1 in 9 died. From the same report it is found that, in Paris for a similar period, the ratio was 1 in 8 for the medical patients. One in 10, then, will be a fair expression of the usual ratio of deaths to cases admitted to hospitals. Any one, however, who has any knowledge of these institutions, will readily understand that this does not express the actual ratio of mortality and sickness which prevails among the classes of people who become the inmates of hospitals. It is known that large numbers are excluded from these institutions, in consequence of the limited accommodations which they afford, especially in this State, and on account of the restrictions as to the classes and conditions of disease which are admitted for treatment, chronic cases, as a general rule, being excluded; further, a very large number of persons receive treatment as out-patients and at various dispensaries, a large proportion of whom are temporarily prevented from pursuing their ordinarily avocations.

The fact that this estimate is exceedingly low may be illustrated more definitely by a comparison of the above ratio, which was found to obtain in British hospitals, with that which prevailed among the average number of troops serving in the United Kingdom of Great Britain and Ireland during the year 1872, as published in the Army Medical Report for that year, when the average ratio showed a considerable reduction as compared with that of the previous ten years. The average strength of the army was 92,218, of which number 72,236 were admitted to the hospital and 714 died, or about 1 in 100, though women and children do not enter into this estimate, and it is known that they contribute most largely to the sickness-rates in public and private records.

We may double our previous estimate, therefore, and assume the ratio of twenty cases of sickness, incapacitating from labor, to one death, and still be below the probable ratio, as will be evident from the succeeding calculations. Indeed, Dr. Playfair, of England, after careful inquiry, computed the ratio of one death to twenty-eight cases of sickness for a mixed population of all ages.

If, now, we estimate upon this basis for 1870, the year of the census, during which the mortality was comparatively low, it is found that 27,329 deaths were recorded in the whole State; hence there would have been 546,580 cases of sickness during the year, or only about four daily for each city and town.

In eight of the largest hospitals of Great Britain, the average duration of treatment of medical patients is 28.9 days, and of surgical patients 35.5 days. In the Boston City Hospital, during 1873, it was 23.2, and in the Massachusetts General Hospital 32.8 days, no distinction being made between the medical and surgical patients, in the reports of these institutions. Bearing in mind that these patients, as a rule, have been sick a few days before admission, and rarely resume their ordinary occupations until at least several days have elapsed after their discharge from the hospital, we may safely assume thirty-five days as the average period for which these patients are incapacitated by sickness.

Given, then, the number of sick persons and the average duration of illness, the result is a total annual loss of 19,130,300 days, which number, divided equally among the total population for the year 1870, would give 13.1 days for each individual, results which do not differ materially from that obtained by the first method of calculating.

It may be objected to these computations, that these periods do not represent the true loss of time, in a pecuniary point of view, from the fact that they apply to the whole population and not to the working portion alone. Admitting this to be a valid objection, a reduction in the above estimates may be made as follows.

From the United States Census Report of 1870, it appears that the total number of persons in the State, engaged in all classes of occupations, was 579,844 or about 39 per cent. of the entire population. Making use of our first estimate, then, by which we computed an average annual loss of fourteen days by each individual, during a period of eight years, and calculating for the working population alone, the original estimate would be reduced to 7,633,661 days, or 20,914 years, representing the total average loss of working-time by sickness during one year.

In the paper by Dr. Jarvis, to which reference has already

been made, a computation is made for the purpose of determining the approximate amount of sickness in this State, during the year 1870, among the people of the working age, twenty to seventy, from which it appears that the total period during which so much opportunity for labor was lost, was 24,553 years, 3,639 years more than we obtained by the above calculation. It will be evident, therefore, that our estimate is sufficiently low.

It is further shown by Dr. Jarvis, that, during the same year, the premature deaths represented a still greater loss to the productive power of the State, a matter of exceedingly great importance, the consideration of which, however, does not come within the scope of the present paper.

It would be impossible to obtain even an approximate idea of the actual cost of these millions of sick-days to the State. A low estimate, however, will be astounding to the many who have never taken the subject into consideration.

The following table, derived from the Fifth Annual Report of the Bureau of Statistics of Labor of Massachusetts,

[From U. S. Census Report—1870.]

Shows four classes of occupation, employing $41\frac{38}{100}$ per cent. of the males above sixteen years of age, $74\frac{65}{100}$ per cent. of the females above fifteen years of age, and $73\frac{66}{100}$ per cent. of the youth, of all employed in manufactures and mechanical industries, in Massachusetts.

BRANCH OF MANUFACTURE.	Number Employed.	SEX AND AGE.			Wages.
		Males above 16 years.	Fem. above 15 years.	Youth	
Textiles,	72,464	27,256	36,409	8,799	\$23,656,614
Boots, Shoes & Leather,	60,384	48,000	11,225	1,159	30,417,622
Straw Goods, . . .	11,441	1,113	10,003	325	1,411,350
Men's Clothing, . .	9,878	3,031	6,730	117	3,815,742
Total,	154,167	89,400	64,367	10,400	\$59,301,388

Taking into consideration the class of people indicated by this table, their numbers and the character of their occupations,

we may safely rely upon its affording a just estimate of the average wages which are received by the mechanical and manufacturing portions of the State; and, further, it will furnish a low estimate of the average receipts of the entire working population.

Dividing the total wages by the total number employed, it appears that \$7.40 represent the average amount received weekly by each individual; and, therefore, it may safely be assumed that one dollar per day will denote the minimum loss in wages to those who are disabled by sickness.

But the loss of pay is not the only tax imposed upon the sick, for they necessarily incur greater or less expenses for medical attendance, medicines, nursing, etc., while the ordinary expenses of living, for the individual or household, must still be provided for.

An idea of these expenses may be obtained by reference to the cost of maintaining hospitals, where the large numbers of patients reduce the average expenses; at the same time, there are no charges for professional attendance, and in the estimates, no account is taken of the interest on the investments in land, buildings, etc. A review of the expenses attending the conduction of the two large hospitals in the city of Boston, shows that the average cost of each patient is over nine dollars per week; while, for all the state institutions, the average cost of each inmate, during 1872-3, was about three dollars per week; but a large number of these inmates are not sick; and, furthermore, many of them contribute, in various ways and largely, to the support of the institutions, while the general expenses for management and supplies, obviously, are much less than is the case in hospitals.

With reason, then, two dollars, per day and individual, may be regarded as the minimum average cost of sickness to the working-people, in this State, from loss of wages and the attending expenses. If, now, the number of working days lost annually, be multiplied by two, it is found that the total annual loss to the State, by sickness alone, at the lowest calculation, is \$15,267,322; and if we compute in the same way for the entire population, this amount would be increased to an average of \$39,146,980.

When we consider the amount of misery and suffering

which these statements imply, both in a moral and physical sense, and the prevalence of pauperism and crime, which are directly traceable to the paralyzing influences of debt incurred by sickness, humanity alone must utter its loudest protest against the existing condition of sanitary matters, which is responsible for such a destruction of the moral, vital and productive energy of this State; but it is our present object to show that it is the interest, as well as the duty, of each and every one to endeavor to diminish the excessive rate of sickness and mortality.

Naturally, the question arises, Is it possible to accomplish this end in our State? Natives and citizens of Massachusetts are wont to boast of its high attainments in literature, the arts and sciences. In education, wealth, general industry, philanthropy and charity, we can claim, at least, to be the peer of any of our sister States. Does our sanitary condition, as indicated by the mortality, place us in an equally favorable light? The following observations will serve to show that, in the matter of health, there is opportunity for improvement, and, further, that a change for the better is possible.

From the United States census report for 1870, it appears that, with the exception of Arizona and Louisiana, the death-rate of Massachusetts, for that year, was higher than that of any other State in the Union. A comparison of this nature, however, obviously leads to no definite conclusion, for many permanent causes of disease come into play, in the different States, to increase or diminish the amount of sickness and mortality; and, further, it is to be remembered that the density of population in Massachusetts, about one hundred and eighty-seven to the square mile, is greater than that of any other State.

If, however, a comparison be made between the mortality of this State and that of different cities, in which case the relation of density of population is reversed, it is found that this State presents a very unfavorable condition, as will appear from an analysis of the following table, which is derived from the Report of the Board of Health of New York City, for 1872:—

CITY.	STATE.	Population.	Deaths in 1872.	Death-rate per 1,000 Inhabitants.
-	<i>Massachusetts,</i>	1,541,542*	35,019	22.7
New York,	New York,	1,000,000*	32,647	32.6
Philadelphia,	Pennsylvania,	728,000*	18,987	26.1
Brooklyn,	New York,	450,000*	12,648	28.1
St. Louis,	Missouri,	400,000*	8,047	20.1
Chicago,	Illinois,	367,293	10,156	27.6
Baltimore,	Maryland,	300,000	7,546	25.1
Boston,	<i>Massachusetts,</i>	265,000*	8,089	30.5
Cincinnati,	Ohio,	250,000*	5,116	20.5
New Orleans,	Louisiana,	200,000*	6,122	30.6
San Francisco,	California,	188,323	3,232	17.2
Buffalo,	New York,	150,000*	2,594	17.3
Cleveland,	Ohio,	120,000*	2,337	19.5
Newark,	New Jersey,	115,000*	3,636	31.6
Washington,	District of Columbia,	110,000*	2,230	20.3
Detroit,	Michigan,	100,000*	2,390	23.9
Albany,	New York,	95,000*	1,877	19.7
Milwaukee,	Wisconsin,	90,000	1,961	21.8
Pittsburg,	Pennsylvania,	86,076	2,353	27.3
Providence,	Rhode Island,	72,910	1,610	22.1
Rochester,	New York,	65,424*	1,188	18.3
Richmond,	Virginia,	60,000*	1,714	28.6
Memphis,	Tennessee,	55,000*	2,561	46.6
New Haven,	Connecticut,	55,000*	1,215	22.1
Alleghany,	Pennsylvania,	53,180	1,270	23.9
Troy,	New York,	50,000*	1,702	34.0
Charleston,	South Carolina,	48,956	1,557	31.8
Worcester,	<i>Massachusetts,</i>	47,500*	1,383	29.1
Lowell,	"	45,000*	1,046	23.2
Cambridge,	"	44,000*	1,068	24.3
St. Paul,	Minnesota,	40,000*	708	17.7
Fall River,	<i>Massachusetts,</i>	40,000*	1,067	26.7
Hartford,	Connecticut,	40,000*	633	15.8
Wilmington,	Delaware,	37,000*	772	20.9
Portland,	Maine,	33,000*	760	23.3
Dayton,	Ohio,	30,473	608	19.9
Lawrence,	<i>Massachusetts,</i>	30,000*	692	23.1
Manchester,	New Hampshire,	30,000*	608	20.2
Quincy,	Illinois,	30,000*	477	15.9
Evansville,	Indiana,	30,000*	789	26.3
Lynn,	<i>Massachusetts,</i>	30,000*	598	19.9
Charlestown,	"	28,330	769	27.1
Savannah,	Georgia,	28,235	1,108	39.2
Elizabeth,	New Jersey,	27,000*	371	13.7
Peoria,	Illinois,	26,000*	429	16.5
Salem,	<i>Massachusetts,</i>	26,000*	602	23.1
New Bedford,	"	23,000*	521	22.6
Hoboken,	New Jersey,	22,000*	723	32.9
Chelsea,	<i>Massachusetts,</i>	21,000*	384	18.3
Galveston,	Texas,	20,000*	559	27.9
Petersburg,	Virginia,	20,000*	539	26.9
Terre Haute,	Indiana,	20,000*	365	18.2
Wilmington,	North Carolina,	18,000*	430	23.9

* In these cities the population is estimated, and in others it is actual.

CITY.	STATE.	Population.	Deaths in 1872.	Death-rate per 1,000 Inhabitants.
Sacramento, . .	California, . .	16,298	352	21.6
Burlington, . .	Iowa,	16,000*	157	9.8
Gloucester, . .	Massachusetts, . .	16,000*	351	21.9
Denver,	Colorado,	16,000*	135	8.4
Vicksburg, . . .	Mississippi, . . .	15,000	548	36.5
Jacksonville, . .	Florida,	10,000	134	13.4
London,	England,	3,311,298	70,893	21.4
Paris,	France,	1,851,792	39,111	21.1

* In these cities the population is estimated, and in others it is actual.

From this table it appears that the death-rate of this State, for 1872, was greater than that in more than half of the larger cities of the country; that only a few cities—namely, New York, Brooklyn, Chicago, Baltimore, New Orleans, Newark, Pittsburg, Richmond, Memphis, Troy, Charleston, Evansville, Savannah, Hoboken, Galveston, Petersburg, and Vicksburg, nine of which are Southern cities—show a notably higher rate; that the mortality of the whole State was greater than that of London or Paris; and, finally, that the larger cities of the State present a very unfavorable sanitary condition, especially when compared with those which contain nearly an equal number of inhabitants.

From the next table it is found that, in 1872, there was a marked increase in the death-rate of the State, while during the previous six years, after the close of the war, it varied but little.

[From the 31st Reg. Rep. of Mass. for 1872.]

YEARS.	Population.	Deaths to 100 living.	No. living to one death.
1866,	1,303,116*	1.815	55
1867,	1,340,229*	1.691	59
1868,	1,378,398*	1.852	54
1869,	1,417,654*	1.838	54
1870,	1,457,351	1.875	53
1871,	1,498,856*	1.864	54
1872,	1,541,542*	2.272	44

* Estimated.

If now, in connection with the last table, we analyze the succeeding one, taken from the same registration report, together with that of 1870,—

DEATHS.							CAUSES OF DEATH.	DEATHS TO 100,000 POPULATION.						
1866.	1867.	1868.	1869.	1870.	1871.	1872.		1866.	1867.	1868.	1869.	1870.	1871.	1872.
24,683	23,779	26,653	27,148	28,348	29,333	36,302	All Causes,* . .	1,937.44	1,851.56	2,009.33	1,874.79	1,945.17	2,012.72	2,490.10
24,105	23,301	25,189	25,713	26,998	28,043	34,845	Specified Causes,* .	1,892.07	1,817.48	1,955.66	1,775.68	1,852.54	1,924.20	2,390.15
							(CLASSES.)							
5,861	5,506	6,869	6,898	6,916	6,544	10,792	Zymotic Diseases, .	460.04	429.46	533.31	476.36	474.56	449.02	740.27
6,422	6,129	6,299	6,569	7,185	7,272	8,042	Constitutional Dis.,	504.08	478.06	489.05	453.64	493.02	498.98	551.63
6,469	6,343	7,157	7,177	7,556	8,160	9,617	Local Diseases, .	507.78	494.76	555.67	495.63	518.47	559.91	659.67
4,378	4,432	3,865	4,027	4,206	4,771	5,103	Developmental Dis.,	343.64	345.70	300.07	278.09	288.61	327.36	350.03
975	891	999	1,042	1,135	1,296	1,291	Violent Deaths, .	76.53	69.50	77.56	71.96	77.88	88.93	88.55

* Including still-born.

it will be observed that the rate of mortality has been increasing gradually; that, previous to 1872, the mortality, included under constitutional, local, and developmental diseases, shows comparatively slight variations, from year to year, though, as a general thing, there was a gradual increase in the rate; that, in 1872, these same diseases furnished a higher rate of mortality than during either of the previous years; finally, that, during 1872, there was a very marked increase in the number of deaths, included under the head of zymotic diseases, over all the previous years, during which the rate varied inconsiderably.

To recapitulate the facts which have been adduced to illustrate the statement that there is opportunity for improvement in the sanitary condition of our State, it is found that the mortality-rate is higher than that of any other State in the Union, excepting Arizona and Louisiana; that it presents an unfavorable comparison with many of the larger cities of the country, with London or Paris; that the death-rate is increasing gradually; and that, in 1872, while there was an unusual increase in the rate of mortality from all diseases, the affections included under the head of zymotic diseases occasioned a notably large number of deaths.

This last fact alone furnishes a strong confirmation of the second portion of our statement, namely, that a change for the better in this State is possible; for, while it is known that the province of preventive medicines is not limited to any single disease, or any class of diseases, the results of all experience and researches go to show that its greatest influence is exerted in the direction of those affections which are included under the head of zymotic diseases in registration reports, a very large proportion of which are known to be due to removable causes.

Again, during the year 1872, there were recorded 1,029 deaths from small-pox, "which has never appeared in such relations since registration was established in Massachusetts," and the fact that it did so appear in that year, affords a striking illustration of our general line of thought, that individuals, communities, and the State as a whole, have been remiss in their duties to themselves and to one another in not employing all available means for the prevention of disease, since it

cannot be denied that the adoption of proper precautions might have prevented many, if not most, of the deaths from this cause in that year, as was done in the succeeding year.

It is a very common belief that an increased *rate* of mortality is the necessary result of an increase in the density of population. That this is a very general result cannot be denied; but that it is a *necessary* one, we think, admits of question,—a point which may well be illustrated by reference to the sanitary condition of London, as indicated by the rate of mortality which was computed for a long series of years by Dr. Greenhow. He states that, during the decennial period, 1681 to 1690, the population of that city was about 530,000, while the death-rate, on the average, was about 42 in a thousand.

During the period, 1746 to 1755, with a population of 653,000, the mortality was 35 in a thousand. From 1846 to 1855, the number of inhabitants had increased to 2,362,236, yet the death-rate was reduced to 25 per thousand, notwithstanding the fact, that during this period occurred the cholera epidemics of 1848-49 and 1854-55. Since 1856, the population has increased to 3,311,298, estimated to the middle of 1872; while the death-rate has shown a gradual reduction, until, for that year, it was only 21.4 per thousand.

This same point is confirmed by the experience of other parts of England, where, during the past twenty-five years, constant efforts have been made to reduce the mortality by means of improvements in the sanitary condition of the people, and principally in the way of improving the facilities for water-supply and drainage. The beneficial effects of these endeavors have been proved statistically in the reports of the medical officer of the privy council, wherein it is shown that, in twenty-four cities and towns, with a population varying between 160,000 and 4,000, the average death-rate was reduced from 24.7 per thousand to 21.9, after the introduction of improved sanitary works,—chiefly in the way of furnishing good water-supplies and efficient drainage.

M. Deville, in a report addressed to the Prefect of the Seine, in 1864, showed that, during a period of twenty years (1841 to 1861), the mortality of Paris was reduced from the ratio of 1 death to 36 inhabitants to that of 1 to 39. Accord-

ing to the statement in the table, which is given on page 67, the rate was still further reduced, in 1872, to 1 to 47.

There may be many who find satisfaction in the belief that, previous to the year 1872,—which they would regard as an exceptional one from unavoidable causes,—the mortality of the State was as low as could reasonably be expected, taking all things into consideration. With such we might agree, perhaps, when we call to mind the existing condition of sanitary arrangements throughout the State. But, in addition to the fact which we have shown, that the entire State and our larger cities compare unfavorably with other States and other cities, it will be observed, upon an analysis of the preceding tables, that the rate of mortality shows, on the whole, a constant increase; though, to be sure, it is not very marked. Moreover, this comparatively slight increase in the past is, by no means, a guarantee of a similar record for the future; indeed, the very fact of a constantly increasing *death-rate* indicates even a neglect of additional precautionary measures, which ought to be made in order to compensate for the greater density of population and the accompanying dangers to health and life,—a neglect which inevitably will find its expression in a higher sickness and mortality rate, as it did notably in the year 1872, when, from zymotic diseases alone, there were 4,248 deaths more than during the previous year in this State. This increased mortality we have allowed was unavoidable under the existing sanitary circumstances; but the sequel of the small-pox epidemic in that year ought to teach an important lesson; for, as that dread disease was literally stamped out,—it is to be hoped never to return,—under the immediate stimulus of private and public interests, so may the ravages of other diseases be checked, in a great measure, by individual, corporate and united action.

Our State, it is true, affords many examples of the beneficial results of sanitary improvements, which have had their origin in the greater or less appreciation of the community of interest which exists between the individual and his town or city; but the preceding observations will serve to show that these improvements are still inadequate to the full realization of the demands of sanitary science. The mortality from consumption alone has shown a constant reduction for several

years ; a result which is due, in a great measure, to improved drainage, as has been indicated by Dr. Bowditch, and demonstrated more fully, perhaps, by the recorded experience of many English towns, as will appear from the following table, which is given by Baldwin Latham in his work upon Sanitary Engineering, in order to illustrate the benefits which followed the introduction of efficient works for sewerage and water-supply :—

NAME OF PLACE.	Population in 1861.	Average Mortality per 1,000 before Construction of Works.	Average Mortality per 1,000 since Completion of Works.	Saving of Life, per cent.	Reduction of Typhoid Fever, rate per cent.	Reduction in rate of Phthisis, per cent.
Banbury, . . .	10,238	23.4	20.5	12 $\frac{1}{2}$	48	41
Cardiff, . . .	32,954	33.2	22.6	32 $\frac{1}{2}$	40	17
Croydon, . . .	30,229	23.7	18.6	22	63	17
Dover, . . .	23,108	22.6	20.9	7	36	20
Ely, . . .	7,847	23.9	20.5	14	56	47
Leicester, . . .	68,056	26.4	25.2	4 $\frac{1}{2}$	48	32
Macclesfield, . . .	27,475	29.8	23.7	20 $\frac{1}{2}$	48	31
Merthyr, . . .	52,778	33.2	26.2	18	60	11
Newport, . . .	24,756	31.8	21.6	32	36	32
Rugby, . . .	7,818	19.1	18.6	2 $\frac{1}{2}$	10	43
Salisbury, . . .	9,030	27.5	21.9	20	75	49
Warwick, . . .	10,570	22.7	21.0	7 $\frac{1}{2}$	52	19

The results of these improvements, in the direction of typhoid fever, as indicated by this same table, acquire especial interest in connection with our present inquiry, since this disease is one of the most prominent causes of mortality in our State, and all the more when it is borne in mind that "this is a disease of scattered communities rather than of crowded towns, of rural rather than of urban districts," as is shown by the annexed table, which is given in a paper contributed by the late Secretary to the Second Report of this Board, upon "the causes of typhoid fever in Massachusetts."

	Population, 1865. (All ages.)	Total deaths from Typhoid in ten years.	Average No. of Persons living each year to one death.	Average No. of deaths each year to 1,000 persons living.
One hundred and forty-seven (147) cities and towns of more than 2,000 inhabitants,	1,044,294	7,888	1,323.90	0.755
One hundred and eighty-four (184) towns of less than 2,000 inhabitants,	213,468	2,539	840.75	1.189

Evidence is adduced in this paper by Dr. Derby, to show that the introduction of pure water into our cities has been followed by a mitigation in the severity of this disease, and a diminution in the number of cases and mortality-rate, *but in no very striking degree*. The explanation of this last fact, he found in the conclusions to which his investigations led, and which he stated in the following words:—"The single continuous thread of probability which we have been able to follow in this inquiry, leads uniformly to the *decomposition of organized* (and chiefly vegetable) *substances*, as the cause of typhoid fever as it occurs in Massachusetts."

"Whether the vehicle be drinking-water made foul by human excrement, sink drains, or soiled clothing; or air made foul in inclosed places by drains, decaying vegetables or fish (Swampscott), or old timber (Tisbury), or in open places by pigsties, drained ponds or reservoirs, stagnant water, accumulations of filth of every sort, the one thing present in all these circumstances is decomposition."

In other words, while different cities and towns in the State have improved their sanitary condition, by providing an abundance of pure water, they have universally neglected, to a greater or less degree, to afford protection against the equally, if not more, pernicious effects of impure air. Moreover, it is a well-known fact, that in most of our towns, few or no provisions are made for securing the blessings which are afforded by pure air and clean water.

The conclusions which, we believe, we are warranted in drawing from all the preceding observations, may be summed

up in the following words: the sickness and death-rates in our State, in towns as well as in cities, are higher than they ought to be, with our present knowledge of the origin of diseases, and of the means at our command for their prevention. While these high rates point distinctly to important and serious effects upon the social, moral and political life and physical well-being of the State, they likewise imply an excessive annual monetary tax, which impedes, to a considerable extent, the prosperity of the Commonwealth.

In conclusion, it will be instructive to form some estimate of what may be saved by a reduction of the mortality; in other words, to give a practical illustration of the fact that it is practising true economy to encourage the study, and follow out the teachings, of sanitary science.

Statisticians have calculated that 11 to one thousand represents the lowest death-rate which can be attained; that this mortality is unavoidable. Instances, however, are not wanting, even in this State, to show that this is not necessarily the lowest limit; but these are quite uncommon. Cities of this country and Europe have never reached this rate, nor is it probable that they will. In London, the standard sought to be obtained is 17 per thousand, though this limit has always been exceeded.

During eight years, 1865 to 1872, inclusive, the period for which the calculations were made in the first part of this paper, the average rate of mortality in this State was 19 per thousand. If now the limit of 15 per thousand be adopted, it will not be unreasonable, for in 1867 the rate was only 16.9. The following calculations will show the minimum annual amount which would be saved to the State, if this reduction of only 4 per one thousand be effected.

During the period mentioned, the average population was 1,401,000, in round numbers. With a death-rate of 19 per one thousand, the annual mortality would have been 26,619, while the rate of 15 per one thousand would represent a reduction in the number of deaths to 21,015, or 5,604 less than under the former conditions.

In the former part of this paper it was shown that we might assume, upon good grounds, that every death represents a total of 730 days' sickness and disability. The above

reduction of 5,604 deaths, therefore, would indicate a saving of 4,090,920 days' sickness. Reckoning, also, as before, the minimum total cost of sickness, per day and individual, to be two dollars, then the total annual reduction in the cost of sickness throughout the State would amount to the sum of \$8,181,840. Calculating, however, for the working population alone, in the same way as before, this sum would be reduced to \$3,190,916.

The latter large sum would be an actual annual saving to the State, and hence it would represent the interest upon a capital, which, reckoning upon the basis of six per cent. interest, would amount to \$53,181,933. In other words, in order to effect a reduction, in the annual mortality, of only 5,604, or at the rate of 4 per one thousand, the State might expend a capital of over fifty-three millions of dollars in sanitary improvements, and the sum invested in this manner would continue to return interest, at the rate of six per cent. per annum.

If it is remembered that, in all the preceding calculations, we have endeavored to make use of low estimates only, and, further, that no account has been taken of the actual and immense loss to the State, resulting from a very large number of premature deaths and during the working age, a matter which has been quite fully illustrated by Dr. Jarvis, it must be apparent to all that, with the State as with the individual, the promotion of health is true economy.

ON THE TRANSPORTATION OF LIVE-STOCK.

By J. C. HOADLEY, Esq. (OF LAWRENCE),
MEMBER OF THE BOARD.



ON THE TRANSPORTATION OF LIVE-STOCK.

Gentlemen of the State Board of Health.

Early in the current year you did me the honor to assign to me the duty of preparing, for our next annual report, a paper on the transportation of live-stock, considered in its economical, sanitary and humane aspects.

Feeling deeply the importance of the subject, and conscious of very imperfect qualifications to treat it adequately, I yet undertook it, with secret reluctance, only because I felt it to be a duty which I ought not to evade.

Without special knowledge of the subject, at the outset, I have sought to inform myself by correspondence, by conversation with experts and men of experience, by the perusal of such printed matter, bearing upon it, as I could collect, in this country and in Europe; and, to give distinctiveness and accuracy to information so acquired, by personal observation.

From Mr. Lucien Prince, of Worcester, whose knowledge of all that relates to the transportation, by railroad, of horses, beef-cattle, sheep and swine, on all the great routes converging to our markets, is both accurate and extensive, I obtained much valuable information and assistance in my personal investigations.

It is almost impossible to overstate the importance of this subject. It touches society at all points, and nowhere lightly.

The importance of an abundant and regular supply of food, at moderate price, is felt by all; and, to such supply, the best method of transporting live-stock, or some available substitute, such as the safe transportation of dressed-meats, seems absolutely essential.

The importance to the public health, of wholesome and nutritious viands, free from suspicion of deleterious taint, will

not be denied, and these cannot be obtained by methods of transportation injurious to the health of the animals transported.

The importance, to the morals of the community, of removing the debasing and degrading spectacle of needless suffering, if such exist, from the great highways of travel, will not be generally disputed.

The movement of live-stock by rail has already reached vast proportions, and many causes conspire to augment it year by year.

The growth of population in this country, as in all others, is, for the most part, the growth of cities; and growing cities must draw their supplies of food from an ever-widening area.

The remarkable diffusion of luxury, seen on all hands, is no less observable in the increased consumption of butchers' meat, than in domicile, equipage, dress and amusement; and, while less obtrusive than other forms of luxury, it is yet of vast importance, by reason of the breadth to which it extends among the mass of the population.

Salt pork, salt beef, salt fish, which, with rye-flour, indian-meal, potatoes, turnips and cabbages, formed almost the exclusive diet of the people forty years ago, when fresh meat, wheaten bread and sweetened food were sparingly used as rare and costly dainties, have given place, to an immense extent, to fresh meats, fresh fish, oysters, white bread made of fancy brauds of wheat-flour,—too generally ill-made and underdone, indeed,—to sweetened pies, cakes and puddings, fruits, and the more delicate vegetables.

Desirable as this change may be, on the score of health, comfort and refinement, its effect on the sources of supply is obvious and undeniable.

This diffusion of luxury, shown by the increased consumption of butchers' meat by all classes of the people, save the very wealthy, who can generally command such a diet, and the very indigent, to whom it can never be regularly accessible, is most strongly developed in cities; so that the diffusion of luxury and the growth of cities unite to produce a joint and cumulative effect.

The increase of commercial and manufacturing cities, and the spread of manufacturing and mechanical establishments throughout the State and the adjoining country, would result,

even more than it is observed to do, in a diminution of the home supply of cattle, sheep, swine and domestic fowls, but for the greatly enhanced prices given to beef, mutton and poultry, by the ever-increasing demand;* and, in spite of this

* The following statements are condensed from a paper on beef cattle, in "Griffith's Annual Live-Stock Review" for 1873, pp. 10, *et seq.*; but having found, on collating the figures with those contained in the reports of the census, numerous discrepancies, due, apparently, to the editor's having drawn them from another source,—probably the reports of the agricultural department,—I have substituted the figures given in the census reports.

In 1860, according to the reports, there were, in the whole United States, a grand total of 28,967,028 head of beef cattle, including milch cows, working oxen and other cattle, as well in cities and villages as on farms.

After a lapse of ten years the number appears, not only not to have increased, but to have slightly diminished; the number in 1870 being only 28,074,582,—a falling off of 892,446, equal to nearly 3.1 per cent.

During this same decade, the population rose from 31,443,321 in 1860 to 38,558,371 in 1870,—an increase of 7,115,050, equal to 22.6 per cent.

Accordingly, the ratio of the number of head of beef cattle to the population fell off from 92.1 per cent. in 1860 to 72.8 per cent. in 1870. This relative loss was heavy in New England and New York, but was heaviest in the States involved in the rebellion, particularly in those which were the theatre of active hostilities, where the destruction of farm-stock of all kinds was necessarily immense. Something has been done, perhaps, to make up this loss; but on that subject opinions differ, and the data hardly exist for an intelligent decision.

It is estimated by Professor Silas L. Loomis, from a digest of the census returns for thirty years,—reports of 1840, 1850, 1860,—in a paper published in the report of the agricultural department for 1863, that every one hundred people require eighty head of neat-cattle, of which eight must be working oxen, and twenty-eight milch cows; but he points out modifying causes in the habits of the people, such as the substitution of horses and mules for oxen, and the introduction of steam-power, together with the more general use of mutton and other viands, which would, he thinks, reduce the ratio from eighty down to sixty-eight for each one hundred of the population.

Although his facts are not quite accurate, and although his reasoning is not altogether conclusive, we may, perhaps, assume the number at which he arrives—sixty-eight per cent.—as the best ascertainable ratio of neat-cattle to the population, to give an adequate supply of butter, cheese, and milk, of working oxen, and of cattle for the butcher.

According to this assumption, Maine, which possessed a small surplus in 1860, has only just a fair supply for herself in 1870; New Hampshire, which had some to spare in 1860, could part with only 6.2 head to each one hundred of her people, or less than 20,000 head, in 1870; Vermont, although exhibiting a relative loss of about one-fifth, still has a handsome surplus, equal to 36.8 per cent. of her people, or over 121,000 head, in 1870; Massachusetts and Rhode Island, which had rather more than one-third of a supply for their people in 1860, possess in 1870 but little more than one-fourth; and Connecticut, which had in 1860 more than three-fourths, has in 1870 not quite a two-thirds supply. New England, on the whole, has reduced her supply from about .8 of the requisite number in 1860 to about two-thirds. New York stands about the same as New England, although the relative loss has been less, and has in 1870 just .7 of her own supply. New England and New York, taken together, have just one two-thirds supply; and the remaining States and Territories, although show-

countervailing influence, the home supply, *per capita*, does in fact diminish from census to census.

ing a large relative loss, still possess a considerable excess, and bring up the ratio for the whole country to 72.8 per cent.—an excess of one-sixteenth over the number assumed to be required, equal to 1,850,000 head. Table VII. exhibits in even thousands the number of head above and below the assumed ratio, 68 per cent. of the population, possessed in 1870 by each and all of the six New England States, by New York, and by New England and New York together, by the remaining States and Territories, and by the whole United States.

Tables I., II. and III. will be readily understood. It is only necessary to call particular attention again to the fact that the number of cattle in 1860 and 1870 includes those “not on farms,”—that is, milch cows and other cattle in villages and cities, together with those on farms; and that all the figures are drawn from the reports of the eighth and ninth census.

Table IV. shows the course of the trade in cattle in Chicago almost from the beginning. With the exception of two or three of the earlier years,—notably 1858, 1859,—the growth of the business has been very regular; and the ratio of the number shipped to the whole number received remains remarkably uniform, varying but slightly from two-thirds. This table is drawn, with modifications, from “Griffith’s Live-Stock Annual Review”; but some perplexing mistakes in the table in the edition for 1872 are corrected from that of 1870; and I have added the ratios in the last column, for convenience of comparing one year with another.

Tables V. and VI. show the growth and magnitude of the cattle trade of Buffalo and Albany, important points in the line of our chief supply.

The statistics relating to the Boston Live-Stock Market, embracing the Union Market at Watertown and the Brighton Market, have been gathered from the files and memoranda of Mr. George J. Fox, for the past ten years reporter of this live-stock market, expressly for this Report, and are probably the most full and trustworthy now to be obtained. As they possess a certain interest, and are not to be found in a collected form elsewhere, they are here presented in considerable detail.

TABLE I.

Showing the population, the number of neat-cattle, and their ratio to the population, in each of the New England States; the aggregate in New England; the same in New York; and the aggregate in New England and New York, and in the other States and Territories; and the aggregate in the United States. [From the Report of the Eighth Census.]

1860.

STATES AND TERRITORIES.	Population.	Total number Neat-Cattle.	Ratio Per cent.
Maine,	628,279	454,173	72.3
New Hampshire,	326,073	285,721	87.6
Vermont,	315,098	397,136	126.0
Massachusetts,	1,231,066	328,243	26.7
Rhode Island,	174,620	45,249	25.9
Connecticut,	460,147	264,011	57.4
New England,	3,135,283	1,774,533	56.6
New York,	3,880,735	2,004,975	51.7
New England and New York,	7,016,018	3,779,508	53.9
Other States and Territories,	24,427,303	25,187,520	103.1
Total United States,	31,443,321	28,967,028	92.1

Diversified employments, augmented wages, and reduced hours of labor, have produced their inevitable results,—relaxed industry and diminished thrift. Of all the families which, even so lately as thirty years ago, would have kept a cow, a pig and a dozen hens, cared for them after thirteen or

TABLE II.

Showing the population, the number of neat-cattle, and their ratio to the population, in each of the New England States; the aggregate in New England; the same in New York; and the aggregate in New England and New York, and in the other States and Territories; and the aggregate in the United States. [From the Report of the Ninth Census.]

1870.

STATES AND TERRITORIES.	Population.	Total number Neat-Cattle.	Ratio Per cent.
Maine,	626,915	428,826	68.4
New Hampshire,	318,300	236,169	74.2
Vermont,	330,551	346,501	104.8
Massachusetts,	1,457,351	271,315	18.6
Rhode Island,	217,353	40,105	18.4
Connecticut,	537,454	231,094	43.0
New England,	3,487,924	1,554,010	44.6
New York,	4,382,759	2,086,230	47.6
New England and New York,	7,870,683	3,640,240	46.3
Other States and Territories,	30,687,688	24,434,342	79.6
Total United States,	38,558,371	28,074,582	72.8

TABLE III.

Showing the number of neat-cattle in the United States, according to the Reports of the Census in 1840, 1850, 1860 and 1870.

STATES AND TERRITORIES.	1840.	1850.	1860.	1870.
Maine,	322,255	343,339	454,173	428,826
New Hampshire,	275,562	267,910	285,721	236,169
Vermont,	384,341	348,848	397,136	346,501
Massachusetts,	282,574	259,994	328,243	271,315
Rhode Island,	36,891	36,262	45,249	40,105
Connecticut,	238,650	212,675	264,011	231,094
New England,	1,540,273	1,469,028	1,774,533	1,554,010
New York,	1,901,214	1,877,639	2,004,975	2,086,230
New England and New York,	3,441,487	3,346,667	3,779,508	3,640,240
Other States and Territories,	11,530,090	14,432,240	25,187,520	24,434,342
Total, United States,	14,971,586	17,778,907	28,967,028	28,074,582

fourteen hours of daily labor, fed them, almost without cost, on the refuse of their own vegetable diet and on painfully-

TABLE IV.

Receipts and shipments of cattle at Chicago for eighteen years,—1855-1872.

YEARS.	Received.	Shipped.	Packers and City Butchers.	Ratio of Ship-ment to receipts.
1855,	10,715	8,253	2,462	77 per ct.
1856,	31,950	22,502	9,448	70 "
1857,	48,524	25,502	23,022	53 "
1858,	118,155	44,149	74,006	37 "
1859,	90,574	35,973	54,601	40 "
1860,	155,753	104,122	51,631	67 "
1861,	204,579	124,146	80,433	61 "
1862,	209,655	112,745	96,910	54 "
1863,	298,381	203,247	95,134	68 "
1864,	336,627	179,520	157,107	53 "
1865,	333,362	242,766	90,596	73 "
1866,	392,604	262,150	130,454	67 "
1867,	327,650	213,265	114,385	65 "
1868,	324,534	215,987	108,547	67 "
1869,	403,102	294,717	108,385	73 "
1870,	532,964	391,709	141,255	73 "
1871,	543,050	401,927	141,123	74 "
1872,	684,075	510,025	174,050	75 "
1873,	761,428	574,181	187,247	75 "
1874,	843,966	622,929	221,037	74 "
	6,651,648	4,589,815	2,061,833	69 per ct.

TABLE V.

Receipts of cattle, sheep and hogs at the Buffalo Stock-Yards, for sixteen years,—1857-1872.

YEARS.	Cattle.	Sheep.	Hogs.
1857,	108,203	307,549	117,468
1858,	134,073	345,731	92,194
1859,	103,337	189,579	73,619
1860,	156,972	145,354	85,770
1861,	141,929	238,452	101,679
1862,	129,433	524,976	105,671
1863,	154,789	574,849	91,128
1864,	135,797	155,959	301,629
1865,	212,839	207,208	300,014
1866,	275,091	341,560	442,831
1867,	257,872	239,943	607,440
1868,	265,105	385,815	470,578
1869,	247,871	381,450	794,272
1870,	388,057	561,447	239,519
1871,	384,294	551,131	886,014
1872,	379,086	606,748	1,450,109
Receipts of horses, 1868,			7,737
1869,			12,088
1870,			7,896
1871,			13,319
1872,			20,780

gathered garbage, and found in the eggs and chickens, in the milk and spring calf, and in the fall porker, no inconsiderable

TABLE VI.

Albany Live-Stock Market,—Receipts in the five years, 1868–1872.

YEARS.	Cattle.	Sheep.	Hogs.	Horses.
1868,	226,015	670,600	328,100	—
1869,	289,877	656,200	207,500	—
1870,	275,846	590,400	263,200	—
1871,	280,534	683,000	940,500	—
1872,	372,487	714,800	2,035,200	19,456
1873,	404,587	691,200	1,601,200	26,736
1874,	490,000	—	—	—

TABLE VII.

Showing the excess and deficiency of cattle in each of the New England States, in all New England, in New York, and in New England and New York taken together; in the remaining States and Territories, and in the whole United States, in even thousand head.

STATES.	1870.	
	Surplus.	Deficiency.
Maine,	3,000	—
New Hampshire,	20,000	—
Vermont,	121,000	—
Massachusetts,	—	720,000
Rhode Island,	—	108,000
Connecticut,	—	134,000
New England,	—	818,000
New York,	—	894,000
New England and New York,	—	1,712,000
Other States and Territories,	3,567,000	—
Total surplus in United States,	3,567,000	1,855,000

The deficiency here set down for Massachusetts (720,000 head), it will be observed, is not the annual deficiency, but the number which would be required, according to this estimate, to make our State self-supplying for the future. If so many cattle of all grades and ages, with a suitable proportion of bulls, cows, working-oxen, steers, heifers and calves, had been added to her stock, once for all, in 1870, and properly cared for, their natural increase, together with that of her previous supply, would afford annually all the beef, mature and immature, required by her markets. If we assume three years as the mean age at which they would be slaughtered, this would be equivalent to 720,000 divided by 3, or say 240,000 annually. The number actually imported can hardly be stated with accuracy. The 167,730 sold at Brighton are thought to supply 600,000 people,—part of them in adjoining States,—and these people have a partial supply at home,—and some of these cattle are raised in Massachusetts. But if we assume that 600,000 people, in and about Boston, require the importation of 167,730 head of cattle annually, equal to 28 to each 100 of the population, there would still be required an annual importation of 72,270 head to supply the remaining 857,351 people in the State, equal to 8.4 to every hundred, which may not be very far from the mark. But this subject requires more careful examination than I have been able to give it.

part of the year's subsistence, not one-half in similar circumstances now keep either cow or pig.*

On the other hand, the numerous railways which ramify over the plains and prairies, thread the valleys, climb the hills and skirt the shores of our wide and diversified land, gather, along with the various products of the soil, immense herds of cattle and other domestic animals, and pour them into the cities, to satisfy the growing wants and spreading luxury of their increasing population. "The maw of the city is insatiable." New grazing grounds are explored, sources of supply even more remote are laid under contribution, vaster herds are crowded into railway carriages, the journeys become longer if their several stages do not, and the accumulated effect of privations and hardships which, severally, might be comparatively harmless, often shows itself in extreme prostration at the end of a journey of two or three thousand miles.

Railway companies are often slow to perceive the necessity of providing improved accommodation for a rapidly growing business, rarely anticipate imminent requirements, and hardly complete the most necessary improvements before they are found already inadequate.

The wants of this living freight, so simple, yet so imperative, water, food, rest, shelter,† are not always con-

* "Now I've got a cow and a pig," says poor Richard, "every body bids me good-morning,"—titles to social consideration less prized now than in poor Richard's day. If asked for the proof of this assertion, I should give my own observations, the result of many inquiries among intelligent observers of the habits of our village population, and appeal with confidence to all whose memory goes back thirty years, and who have even given a thought to the subject..

† Simple as these requirements are, they are all, save clothing and fuel, which may come under the head of shelter, too, that are required for the physical comfort of man. His wants, as summed up by "Holi chirche," the "Lovely lady of leere," in Piers Plowman's vision, are :

" And comaunded of his curteisie
In commune three thynges,
Are none nedfulle but tho,"

* * * * *

" That oon vesture,
From cold thee to save;
And mete at meel
For misese of thiselve;
And drynke whan thow driest."

[Vision of Piers Plowman, edition of Thomas Wright: John Russell Smith, London, 1856, line 498, *et seq.*]

sidered as much as economy and good policy, to say nothing of humanity, urgently demand. The consequences of these coöperating, and, for the most part, mutually intensifying causes, are to be considered here under three aspects, with a view to such ameliorations as may be found practicable.

1. Economy ; abundant food at reasonable price.
2. The public health ; wholesome food at any price.
3. The public morals ; humanity, which should be beyond price.

The first topic furnishes the key to the question.

It is a humiliating reflection that whatever abuses may be found to exist, will admit of remedy only so fast and so far as economical considerations demand, or at least permit. Fortunately these considerations will be found, it is believed, altogether on the right side. Sanitary and humane considerations, deeply affecting the public at large, often touch individuals too lightly to call out strenuous effort ; but cheap and safe transportation of supplies of food affect, individually, a large body of energetic and active men, who will not fail to make their views and interests tell for all, and more than all, their true relative importance.

Practices and modes of transportation injurious to the health of the animals transported, and therefore, of necessity, prejudicial to the public health,—conspicuously cruel, and therefore degrading to the public morals,—have hitherto prevailed, and, to a certain extent, still continue, because believed to be for the interest of those who carry on the traffic and of the railway companies who conduct it. On the other hand, increased comfort and ameliorations of every kind have been supplied, and will be carried still further, as fast as their adoption can be shown to be profitable.

It must be gratefully acknowledged that the improvements already made have been very marked, and that the severe and sweeping censures to which those who carry on this traffic were a few years ago subjected, whether ever altogether deserved or not, no longer apply with equal justice. The great bulk of the business has passed beyond the purview of societies for the prevention of cruelty to animals, only its

minor evils and its occasional and comparatively rare abuses now requiring their intervention, although their untiring vigilance can never be dispensed with.

Many lines of railway make the transportation of live-stock a leading feature of their business, and strive to attract such freight from rival lines by every attainable improvement in the material and arrangements for the comfort of the animals and of the men who have them in charge.

On some railways, palacc-cars are attached to stock-trains, for the accommodation of drovers and of men in their employ. It is but a very few years since these men were compelled on many lines to ride on top of the stock-cars, without protection from the weather, however inclement, by day or night, and exposed to the most appalling dangers and to extreme hardships; and even now, the wretched "caboose," still in use on some important roads, compares poorly with the corresponding accommodation furnished elsewhere.

Some of the cattle-cars recently placed on the rail are greatly improved over those of earlier date, the latter, of course, still forming the bulk of the equipment, and presenting various degrees of adaptation to their purpose.

Higher speed has been pretty generally attained, and these trains are less frequently subjected to capricious and wanton delays for privileged trains, from which animals suffer great hardships whenever such delays occur. Not only are their hours of confinement and fatigue so lengthened, but their too brief period of rest is sadly curtailed. The requirements of the recent law of the United States* on this subject are

* ACT OF CONGRESS.

An Act to prevent Cruelty to Animals while in Transit, by Railroad or other means of Transportation, within the United States.

[Passed March 3, 1873.]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That no railroad company within the United States, whose road forms any part of a line of road over which cattle, sheep, swine or other animals, shall be conveyed from one state to another, or the owners or masters of steam, sailing or other vessels carrying or transporting cattle, sheep, swine or other animals, from one state to another, shall confine the same in cars, boats or vessels of any description, for a longer period than twenty-eight consecutive hours, without unloading the same for rest, water and feeding for a period of at least five consecutive hours, unless prevented from so unloading by storm, or other accidental causes. In estimating such confinement, the time during which the animals have been confined

now generally complied with at the North, and, so far as my observation goes, to the great advantage of all parties. Not only is the time of actual travel shortened, but the proportionate length of the interval of rest to the time spent on the rail is much increased—a point of great importance.

At many stations, better yards, sheds, mangers and watering-troughs have been provided, and the platforms for embarking and disembarking have been rendered very commodious. Almost invariably, the latest and newest cattle-yards are in all respects the best constructed, the best planned, the best appointed, the most conducive to the health and comfort of the animals, and the most convenient for the men engaged in the business and for the servants of the railway companies. Whatever seems to be objectionable will be found to be old, and to be continued in use only because considered too valuable to be cast aside.

without such rest on connecting roads from which they are received shall be included, it being the intent of this act to prohibit their continuous confinement beyond the period of twenty-eight hours, except upon contingencies herein before stated. Animals so unloaded shall be properly fed and watered during such rest by the owner or person having the custody thereof, or, in case of his default in so doing, then by the railroad company, or owners or masters of boats or vessels transporting the same, at the expense of said owner or person in custody thereof; and said company, owners or masters shall in such cases have a lien upon such animals for food, care and custody furnished, and shall not be liable for any detention of such animals authorized by this act. Any company, owner or custodian of such animals who shall knowingly and wilfully fail to comply with the provisions of this act, shall, for each and every such failure to comply with the provisions of the act, be liable for and forfeit and pay a penalty of not less than one hundred nor more than five hundred dollars: *provided, however*, that when animals shall be carried in cars, boats or other vessels in which they can and do have proper food, water, space and opportunity for rest, the foregoing provisions in regard to their being unloaded shall not apply.

SECT. 2. That the penalty created by the first section of this act shall be recovered by civil action in the name of the United States, in the circuit or district court of the United States, holden within the district where the violation of this act may have been committed, or the person or corporation resides or carries on its business; and it shall be the duty of all United States marshals, their deputies and subordinates, to prosecute all violations of this act which shall come to their notice or knowledge.

SECT. 3. That any person or corporation entitled to lien under the first section of this act may enforce the same by a petition filed in the district court of the United States, holden within the district where the food, care and custody shall have been furnished, or the owner or custodian of the property resides; and said court shall have power to issue all suitable process for the enforcement of such lien by sale or otherwise, and to compel the payment of all costs, penalties, charges and expenses of proceedings under this act.

SECT. 4. That this act shall not go into effect until the first day of October, eighteen hundred and seventy-three.

With some exceptions, to be noticed further on, the arrangements provide humane treatment for all classes of animals in transit, and the animals themselves appear to be calm, quiet, comfortable and contented. Of course these terms are here used in a relative sense. Nobody expects railway travel to prove a luxury, whether to sheep or swine, to horned cattle or horses, to the crowded occupants of the emigrant train or to the passenger in a palace-car, "stretched on the rack of a too easy chair." Some degree of hardship and fatigue are expected, and are probably inevitable, and would do no harm if followed by a suitable period of rest and refreshment for recuperation at the journey's end. I shall return to this point by and by.

Exceptional cases of suffering, sometimes resulting in severe loss, occur often enough to emphasize the demand for watchful supervision, and to prove that a minor, yet injurious, degree of similar hardships may too often escape attention. Such announcements as the following, from the "Buffalo Daily Courier" of Thursday, Sept. 22, 1874, relate to the more startling cases, which happily are comparatively rare:—

"A car-load of twenty-one cattle, from Buffalo, were attacked by a mysterious disorder at Washingtonville, Orange County, on Saturday. Eight suddenly died, and others will die. The disease is conjectured to be an affection of the lungs, caused by the recent dry weather and a long confinement in the cars."

It is not improbable that the crowding of twenty-one cattle into a car of dimensions suitable for only seventeen, for the long journey from Buffalo to New York, may have aggravated the disease, and caused the deaths, with but little to attribute to "the recent dry weather"; but it is hardly to be doubted that these cattle had contracted some distemper before entering the car, or were subjected to unusual delays or other extraordinary hardships. Indeed, some degree of overcrowding is much too common.*

* The following extract from a letter, and the figures subjoined, relating to the stock-yards of Pittsburgh, Pa., which I have not visited, confirms the opinion I had formed independently, that "overcrowding is much too common":—

"The great mortality of stock in the stock-yards of this city is owing to the overcrowding of cars. Texas cattle are less liable to die by overcrowding than native, owing, no doubt, to the amount of nerve with which they are endowed, and also the

Some feeble attempts have been made to guard against this abuse, and to provide for regular feeding and watering by furnishing for beef-cattle compartment cars, containing a number of separate stalls, one for each animal. A trough of boiler iron, for food and water, placed along each side of the car, and a long box overhead for carrying a quantity of food which could be supplied by trap-doors to the troughs below, enabled the attendant to feed the animals without removing them from the car. Water could be introduced into the trough at any watering station.

I could not learn that any satisfactory trial had ever been given to this system.

One car, perhaps more than one, has been sent a few trips, with no very marked results one way or the other, so far as I was able to learn, and the little I was told was contradic-

great length of time they can do without food. The stock-yards in this city are very large, and stock is shipped here continually."

The following are the figures from the Report relating to the Pittsburgh Stock-Yards, referred to in the foregoing letter

STOCK.				Shipped.	Dead.	RATIO.	
						One in,	No. in 10,000.
1871,	{ Cattle,	. . . .		206,384	69	2,991	3.3
	{ Hogs,	. . . .		672,618	2,184	308	32.4
	{ Sheep,	. . . .		758,946	1,807	420	23.8
1872,	{ Cattle,	. . . .		323,687	144	2,317	4.5
	{ Hogs,	. . . .		1,077,817	4,430	243	41.1
	{ Sheep,	. . . .		1,005,156	1,675	600	16.6
1873,	{ Cattle,	. . . .		443,079	551	804	12.4
	{ Hogs,	. . . .		851,582	4,410	193	51.8
	{ Sheep,	. . . .		768,285	1,173	655	15.3
1871, 1872, 1873,	{ Cattle,	. . . .		973,150	764	1,274	7.9
	{ Hogs,	. . . .		2,602,017	11,024	236	42.4
	{ Sheep,	. . . .		2,532,387	4,655	544	18.0

The mortality here shown is very formidable, and calls imperatively for a remedy. The worst feature of the case is, that the ratio of loss to number transported has steadily risen from about one in three thousand, in 1871, to one in eight hundred in 1873; the mean for the three years, 1871, 1872, 1873, being one in twelve hundred and seventy-four,—about one-twelfth of one per cent. The same is true of hogs. The ratio has risen from one in three hundred in 1871 to about one in two hundred in 1873; and the mean for the three years is one in two hundred and thirty-six, or about four-tenths of one per cent. In sheep, on the other hand, there has been some improvement, the ratio of loss having fallen from one in four hundred and twenty, in 1871, to one in six hundred and fifty-five in 1873; the mean being one in five hundred and forty-four, equal to about one-sixth of one per cent.

tory.* I carefully examined a car of this kind, and brought away a strong impression that the cost and trouble attending its use would be considerable, and perhaps greater than any resulting advantage.

Unless the loss now sustained by dealers from the "shrinkage" or loss of weight in transit could be almost wholly prevented, or very largely reduced, these compartment cars can hardly come into use, since there is no other fund from which to draw to cover the enhanced cost, and there would still remain the delay and trouble in loading and discharging, and the greatly increased strain upon the temper and patience of the men employed, necessitating, in some cases, the employment of a higher grade of men about the yards, and more self-control and higher discipline than can usually be expected; which would prove grave impediments to the introduction of a system requiring the separate closing of a partition for every animal, and the placing of every one with his head in a particular direction, when ten trains or more, consisting of thirty to thirty-five cars each, and every car laden with sixteen or seventeen animals, must be loaded within a certain definite time or be left over till the next day. Among the five thousand beeves, freighting such a list of trains, often forwarded daily from a single point, many are almost wild, some quite so, and hardly any sufficiently used to handling to permit themselves to be impounded in a narrow stall without nervous terror and violent efforts to escape. Very often there are pairs of comrades who show strong attachment to each other, and would suffer from separation, and from the violence probably required to effect it.

It is even possible that cattle might be found to suffer more from such solitary confinement than from the present mode, excluding, of course, from the latter the excessive crowding occasionally practised. They could lie down, indeed, at will, without danger of being trampled on by their companions; but they could not turn around, nor move far out of their tracks. No farmer, surely, would dare to put his cows and oxen into stalls only twenty-six inches wide, even to spend a

* Information received while these sheets are under revision for the press, shows that good results are to be expected, and have been in fact obtained; and that there is vitality in this plan, the further development of which will be watched with interest.

single night in a quiet stable. Cattle occupying a car without partitions, unless excessively crowded, and even when far too closely packed to admit of any lying down with safety, can, and actually do, move about by concerted effort, change their position in the car, find their mates and favorites, and obtain some exercise and relief. They support each other against jars and shocks, such as occur in starting and stopping trains, and develop a remarkable degree of discipline and mutual helpfulness and forbearance.

All this would be lost, or much diminished, by the system of compartments, and the loss might go far to counterbalance the gain. Indeed, I was told by one disinterested and intelligent observer, that cattle had been taken out of the compartment car completely foundered, so as to be unable to stand, by a single stage of three hundred miles.

Roomy stalls, affording three feet or three and a half feet to each animal, and assigning eight or ten animals to an ordinary twenty-eight feet car, with suitable manger and watering-trough, good bedding and abundant food, would doubtless give increased comfort, and reduce the loss of weight in transit. If cars so fitted up, mounted on suitable springs, provided with good buffers, and having large axles with long bearings, adapted to high speed, were run rapidly over long routes, there would probably be some saving in shrinkage, and, if so, then a very great gain in the quality of the meat; for the flesh of an animal which, while living, was losing weight, is worth much less, as food, than that of one which was at the time of slaughtering in full and perfect condition. Like the first turn of the screw of the wine-press, the imperative wants of the living animal extract the richest juices and leave the remainder flavorless and poor; and if this self-consuming process is carried to a great extent, the beef that remains is of hardly more worth than a squeezed lemon, or "salt that has lost its savor." * But the loss of weight, or shrinkage, could

* "The application of the substances forming the *albuminous* group, to the support of the animal body, by affording the materials for the nutrition and re-formation of its tissues, needs little explanation. The proportions of the four ingredients of which they are all composed, are so nearly the same, that no essential difference appears to exist among them; and it is a matter of little consequence, except so far as the gratification of the palate is concerned, whether we feed upon the flesh of animals (syntonin), upon the white of egg (albumen), the curd of milk (casein), the grain of wheat (gluten), or the seed of the pea (legumen). All these substances are reduced in the stomach to the form of *albumen*; which is the raw material out of which the various

not be entirely prevented by any possible system of transportation; and so long as any such loss is sustained, there must be some injury to the quality of the meat, for which there is no remedy but feeding, rest and recuperation at the end of the journey.

Unless the exhaustion has passed all necessary limits, this recuperation would be almost as rapid after a journey by the one mode of transit as by the other, and the resulting gain by the use of even the luxurious cars now under consideration could not, it would appear, be very great.

Of course, such a system of wide separate stalls would be costly, cumbrous and troublesome, and probably wholly in-

fabrics of the body are constructed. But the rule holds good with regard to these also, that, by being made to feed constantly on the same substance, boiled white of egg for instance, *or meat deprived of the principle that gives it flavor*, an animal may be effectually starved; its disgust at the food being such, that even if swallowed it is not digested." [Carpenter's Animal Physiology, § 158.] Although the term "ozmazome" is less used than formerly, since the fluid so named has been ascertained to be a compound or mixture of several extracts, rather than a definite substance, it still remains a convenient name for the odorous and sapid portion of the juice of beef and other mature viands, and must always be kept pleasantly in remembrance by the charming work of Brillat-Savarin, 'Physiologie du Gout.'

"We see daily great numbers of beef cattle kept on the road during twelve, twenty, twenty-four, and even thirty-six hours without receiving a particle of food! It is contrary to good sense, adverse to the interests of the shippers, and above all injurious to the health of the animals who undergo these privations, and must suffer much in consequence. *The meat from these animals certainly is not worth as much as that from healthy animals; it is often injurious to the health of man, and always less perfectly digested.* (La viande de ces animaux ne vaut certainement pas la viande saine; elle est souvent nuisible à la santé de l'homme, toujours moins digeste.)" [Améliorations à apporter au mode de transporter des animaux par les chemins de fer. Auguste Zundel, Paris, 1870, pp. 31, 32.]

The following, copied from the annual report of the Union Stock-Yards of Chicago, for the year 1873, published in the "Drovers' Journal" of January 3, 1873, where it is quoted with approval from the "Drovers' Journal" of June 14, 1873, referring to cattle which showed that "this self-consuming process" had been "carried to a great extent," says of them, they are "shipped here with little else than the bone-frame and skin to make up the animal, being totally unfit for any practical use in this market. We know of an instance where an animal of this kind that weighed just 1000 pounds, was sold to a city butcher for fifteen dollars. The party who bought this animal realized just five dollars for the hide, losing the entire carcass; and this kind of a result is no doubt often made in handling this kind of stock." [Report for June.] In the same document, in the report for August, the following language occurs: "The great bulk of 'through' Texas cattle, that arrived at these yards during the month, were sold at \$1.25 to \$2.25, and were dear property at those prices, as all our city butchers lost money in handling them." This, while, at the same time, a few lines further on, we read, "Really fine, ripe cattle sold during the month as high as \$3.25; but the great bulk of the sales of cattle of this class were made at \$5.90 to \$6.10."

In view of these facts, I hardly think the energetic comparison of the squeezed lemon too strong. Indeed, it has been strongly confirmed and approved as apposite and just by numbers of experts in the cattle trade.

admissible on economical and practical grounds. It may be adopted in some degree for very fine and valuable animals, but it would enhance the cost of transportation of ordinary cattle out of all proportion to their market-value. Just so far as the saving in shrinkage and the augmented value of the animals will compensate shippers for this extra expense, and afford a remunerative profit on the capital employed, will the use of such cars be found practicable and judicious, and to just this extent will they, doubtless, be introduced in time.

Some of the worst abuses at present existing arise from the great disparity of size among the cars of the leading railways which supply our market. Cattle are rarely, if ever, shipped from a distant point through to their ultimate destination in the same cars in which they set out. Herds are concentrated and, to some extent, commingled at such stock-yards as those at St. Louis, Louisville, Chicago and Pittsburg. They move on to Toledo, to Cleveland, to Detroit, to Buffalo, to Albany, receiving accessions from the tributary country through which they pass, and diverge and separate at such points as Buffalo and Albany, for New York, Boston and other markets, and at each relay are forwarded in cars other than those in which they arrived.

These cars differ greatly in dimensions, especially in length. Some are thirty-two feet long by eight feet six inches wide, and six feet six inches high, inside dimensions; some, again, are only twenty-five feet long by seven feet eight inches wide, and six feet high. In most cases, doubtless, more of these small cars are provided to receive a train load of cattle than there were of the larger cars in which they came from the West; but in too many cases shippers are compelled, to their very great injury, to put the seventeen heavy steers which formed a car-load, and found suitable space in a car twenty-eight feet, thirty feet, or thirty-two feet long, into one of only twenty-five feet, to the great discomfort and possible loss of the animals, or submit to ruinous delay, with no assurance of better accommodations at last.*

* It is but fair to say that the very smallest of these cars have just now, upon suitable representations to the officers of a leading railway, been removed from cattle-trains and applied to other purposes to which they are better adapted.

The requirements of a good cattle-car are,—

1. That it should not be less than eight feet wide in the clear, inside ; and eight feet six inches would be better for large cattle.

2. That it should be six feet six inches high in the clear.

3. That it should be not less, nor much more, than twenty-eight feet long inside, since that is the usual length, and uniformity in this respect greatly facilitates re-loading and changing from one train to another.

4. That it should be smooth on the inside, free from angular posts, studs, bars or girders, and from hooks, staples and other projections.

5. That it should be boarded up smooth inside for a width of two feet on the sides, from a point three feet above the floor up to a point five feet above the floor, to afford a fair surface for the animals to rest against, and avoid the sharp corners of open slats, by which they are often cruelly marked.

6. There should be provision for shutting out driving storms on the weather side, in cold weather ; implying, of course, such provision on both sides, to be used at discretion.

7. The riding-springs should be easy, not too easy, but sufficient to obviate all severe jarring.

8. The couplings should be fitted with good buffer-springs.

9. Corners of door-posts should be well rounded, or chamfered.

10. There should be two trap-doors in the roof, to give the attendant access to the cattle in case of need.

11. There should be openings in the ends for ventilation, with doors sliding on the outside, to be closed at the front end in cold and stormy weather.

Cars less than eight feet in width are extremely inconvenient and uncomfortable for large cattle, compelling a constrained, contracted or contorted position of the head and neck, irksome, doubtless, at first, and painful and injurious in the extreme, after long confinement. On at least one railway, the cars are eight feet six inches wide in the clear, and

large cattle are much more comfortable in them than even in a car eight feet wide.*

Bedding.—The propriety, indeed the necessity, of providing bedding of some kind for all neat-cattle, and I believe for horses, hogs and sheep as well, seems to be generally, if not universally, recognized by all railway companies engaged in stock transportation, as well as by shippers. The usual price charged for bedding, so far as my inquiries went, is one dollar per car. For this sum, one hundred pounds of coarse hay or sedge (which is better than fine hay, as it is stronger and less likely to be eaten by the cattle) is supplied to each car, or a quantity supposed to be equivalent thereto of straw, planing-machine shavings, sawdust, or sand. An immense proportion of the cars I inspected were covered to the depth of several inches—sometimes as much as nine inches by actual measurement—with a curious accumulation of strata of all ages, from “eocene” to “recent,” consisting of all the materials enumerated above, with others of unknown origin, all cemented by the droppings of the cattle into a firm but elastic mass resembling kamptulicon. A sprinkling of sand, a quarter of an inch, or even less, in thickness, gives it the tidy appearance of the sanded floor of a London tap-room; and, when care is taken to prevent the formation of deep holes and sharp ridges, and to maintain an even surface, it appears to supply all the conditions of comfort. It is a little appalling, however, to reflect what might be the effect of introducing an animal suffering from any infectious disease into such a nidus for its reception and diffusion.

On some routes, cars used to transport cattle eastward are freighted on the return trip with iron, lumber, coal, or other materials requiring the removal of the bedding at each trip; and in such cases the sprinkling of sand above referred to has to do duty as the sole bedding. It answers to prevent slipping and falling down, and of course to relieve the cattle from the fatiguing muscular exertion which would be necessary on

* *Dimensions of Stock Cars.*—Standard size of stock cars built at the *Boston & Albany R. R.* shops at Allston: 29 feet 9½ inches long, inside; 7 feet 10½ inches wide, inside; 6 feet 2¾ inches high, from floor to ceiling. *Canada Southern R. R.*: 32 feet 4 inches long, inside; 8 feet 6 inches wide, inside; 6 feet 6 inches high inside.

a smooth and slippery floor, but gives no protection against cold and no solicitation to lie down.

"Tenez!" said Fleur de Marie, referring to her lodging-house experiences, "l'on dit que la paille est chaude. Eh bien! on se trompe!" And, if even straw is not warm, a sprinkling of sand must be less so.

For long journeys, extending to the legal limit of twenty-eight hours, and especially in cars which contain only sixteen or seventeen heavy cattle, affording them room to lie down at will and in safety, cars unprovided with the secular bedding above described should have at least a hundred pounds of coarse hay.

Railway companies generally, perhaps universally, fix a tariff of transportation, nominally by weight, but practically by the car, for all but the excess over 20,000 pounds,—that is, the freight is reckoned at the rate agreed on for full 20,000 pounds, whether the car is loaded to that extent or not. All excess is charged by weight, but no allowance is made for underweight.

For fine, heavy cattle, under this system, cars twenty-eight feet in length afford suitable space. Sixteen or seventeen head of such cattle, weighing from twelve hundred to fourteen hundred pounds each, form a car-load, and fill a twenty-eight-foot car just about to the point of comfort. They can lie down and get up at will, move about enough for necessary exercise, and when standing they mutually steady and support each other. They are sufficiently close together for warmth in winter, and they do not suffer for air in summer.

But this rule, while suiting well the requirements of the case for large, well-fattened animals, works considerable hardship in its application to light, thin cattle, often fully grown, tall and long, and with wide-spreading horns, such as the Texas cattle.

It is obvious that the simple rule of weight, 20,000 pounds to the car, as a minimum, irrespective of the condition of the animals, must do injustice to the lighter animals. Their weight is about proportional to the cube of their linear dimensions.

Seventeen cattle, weighing 1,200 pounds each, and 24,400 in the aggregate, in a car twenty-eight feet long, have about

20 inches each; and lighter animals, weighing 1,000 or 1,100 pounds each, require about the same space. In fact, seventeen should be the extreme limit for animals of 1,100 pounds weight and upward, and twenty for full-grown cattle of any weight.

There should certainly be so much space that when one lies down, those on each side of him may stand erect, without being forced by the elasticity of a compressed mass beyond, to either fall over him or to trample him under their feet.

If the limit were set at twenty, and the mean weight of a lot of cattle were so little as 900 pounds, the aggregate weight would be 18,000 pounds,—a loss of ten per cent. to the shipper under existing rules. But equity would seem to require the railway companies to make an average of car-loads; or, in other words, to transport strictly by weight, at all events when the mean car-load is not below 20,000 pounds. In this way, the slight excess of weight in cars loaded with the heavier animals would compensate for the slight deficiency in those loaded with the lighter ones, and justice would be done to all parties.

It need not be objected that such regulations would prove impracticable on account of the trouble they would cause. Hair-splitting refinements would not be insisted on; but sufficient space would be and should be secured.

Nor need it be said that such a law would be disregarded. Of course it would be often disregarded, without efficient inspection and adequate sanctions; but this is true of all laws, and is of itself no sufficient objection to any.*

* For fat cattle, the usual limit by weight, 20,000 to 22,000 pounds to a car, insures sufficient space. It gives a car to 14 or 15 animals, weighing 1,500 pounds each; to 15 or 16 animals, weighing 1,400 pounds each; to 16 or 17 animals, weighing 1,300 pounds each; to 17 or 18 animals, weighing 1,200 pounds each. For cattle of all grades, the working of this rule may be seen in the following table. Car twenty-eight feet long.

Number to a Car.	Weight each.	Aggregate Weight.	Width of space to each, in inches.	Area to each, in sq. feet.	Remarks.
13	1,600	20,800	25.8	17.2	Ample.
14	1,500	21,000	24.0	16.0	"
15	1,400	21,000	22.4	14.9	"
16	1,300	20,800	21.0	14.0	Sufficient.
17	1,200	20,400	19.8	13.2	"
18	1,100	19,800	18.7	12.5	Too close.
20	1,000	20,000	16.8	11.2	"
22	900	19,800	15.3	10.2	Over-crowded.
25	800	20,000	13.4	8.9	"

The far too common practice of crowding twenty-three, twenty-four, or twenty-five tall, full-grown steers into a car of twenty-seven to twenty-eight feet in length, is certainly an abuse which calls for suppression.

Twenty-five animals in a twenty-eight-foot car have just $13\frac{4}{10}$ inches each; less than $13\frac{1}{2}$ inches. What farmer, what cottager, would dare to tie up a cow in a stall $13\frac{1}{2}$ inches wide? It is true that the projecting shoulder-blades and hip-bones, which could not be got into such a stall, find accommodation in the yielding flanks of comrades; but all are of necessity in a state of compression which must impede respiration and cause, when continued for eighteen, twenty, or twenty-four hours, great suffering. Probably no one of them would attempt to lie down from the ordinary impulse to seek relief from fatigue.* The instinct of self-preservation is too strong to permit one to lie down so long as he is able to stand. But once down, whether through sheer exhaustion or an incautious attempt to obtain rest, his fate is sealed. To get up again is impossible.

The elasticity of the compressed mass on each side of him, against which his nearest comrades cannot stand up, forces them together across his prostrate body, and, as they could not possibly maintain a leaning position six or seven inches out of the vertical, sideways, they must trample him under their feet, as they would otherwise be thrown down and share his fate.

Even if they were endowed with reason and tender commiseration, the case would be the same; they must trample a fallen comrade to death. Men, however tender, generous and humane, so crowded, could do no otherwise.

A train of cars arrived at the cattle-yards, in Chicago, at 11.45 A. M., on the 15th Sept., 1874, while I was on the platform, by the Chicago, Burlington & Quincy Railroad from Quincy. There were generally twenty-four Texas steers in each car, the cars measuring, inside, 27 feet 2 inches to 28

* Quadrupeds do not suffer fatigue from standing as human beings do. Their four points of support afford so broad a base, that they stand securely without effort; and fatigue results from voluntary exertion alone. There is no fatigue attending the beating of our hearts, or the other organic, involuntary motions of our bodies. It is because an effort of the will is required on our part to maintain our erect position, that standing fatigues us so soon. The oscillations and shocks of a car may occasion considerable voluntary effort to preserve equilibrium in cars not pretty closely packed, and so give rise to severe fatigue, from which they are saved by being stowed more compactly.

feet in length, by 7 feet 9 inches to 7 feet 10 inches in width, and 6 feet 6 inches high in the clear. One car, marked "H. & St. Jo., No. 1950," measuring 28 feet by 7 feet 9 inches inside, contained on arrival twenty-two living steers and one dead one, trampled to a mass of pulp and gore, the eyelids fallen into the empty socket, and the skin torn and bloody. Each of the twenty-three animals, while all were standing, had a space of 14.75 inches. When one had fallen or lain down, each of the others had 15.5 inches, and the elasticity of the compressed mass closed it over the doomed one, whose fate illustrated anew that "to be weak is to be miserable."

All the other cattle in this car and in the other cars of the train came out lively and active, clearing the bridge from door to platform at a bound, and trotting off to the receiving pens with vigor and alacrity.

These wild cattle, from the fenceless plains of Texas, bear such long journeys and such enforced standing better, doubtless, than pampered and more highly-fed animals of domestic breeds. Accustomed to long daily migrations for food and water, trained to endurance, their bones larger, their muscles firmer, their nerves more vigorous, and but little clogged and burdened with superfluous fat, they suffer little from hardships to which good farm stock would succumb. On the other hand, protracted fasting much beyond their habitual period, sometimes causes them to give out suddenly, because their limited store of fat suffices for aliment in place of food to keep up animal heat but for a limited time.

It is remarked by drovers that when they do fail, they fail all at once.

On the 23d of September, I watched the arrival and disembarkation of several stock-trains at Albany, some of which I had seen loaded at Buffalo about twenty-four hours earlier. One train consisted of thirty-five cars, some containing seventeen heavy cattle, some twenty-lighter ones. Another train contained twenty-one cars loaded with cattle, and several double-deck cars loaded with swine. I succeeded in counting the horned cattle from nine of the cars in this mixed train, as they came out. There were two with nineteen, three with eighteen, three with seventeen, and one with sixteen head. The mean of the nine was seventeen and two-thirds to a car. As these trains

moved slowly past me to their places at the platform, I carefully observed the attitude, expression and general appearance of their inmates. In most of the cars, one animal, at least, was lying down; in several of them, two or three; and in more than one instance, as many as four. They lay quite at their ease, with their legs folded under their bodies, and some of them were quietly ruminating.

Occasionally I waved my hand briskly at one, and he rose to his feet with ease and alacrity. Those that were standing neither incommoded such as were lying down, nor were in the least incommoded by them. While standing they did not quite touch each other, and, consequently, could be subject to no compression. There was room enough for all; and it is not easy to see what would have been gained, on the score of health or comfort, by giving them more space.

Of more than a thousand head of cattle on these two trains, only one came out of the car with any sign of weakness, illness or fatigue; and this one had slipped on entering the car at Buffalo, so that his hind legs had fallen between the car and the platform, bruising him severely, and making him stiff and lame, and, undoubtedly, feverish and ill at ease every way. This is a too frequent occurrence, and although in many cases the injury may be slight and transient, it too often results in severe suffering to the animal, and in incalculable injury to the beef, and danger to the consumer.

Much of this slipping is quite unnecessary.

The platforms are, for the most part, and ought to be always, nearly on a level with the floor of the cars. The space between car and platform is only a few inches, and need be only three or four inches; and, even if there were no bridge, few cattle would make a misstep save on being required to leave a car backward, or when wantonly urged by the dreaded goad to crowd in when the door is filled with others hurrying in as fast as possible. The danger arising from having to back out of a car can only be lessened, not quite prevented, by keeping the bridges in good order, and securely and accurately placed. Sometimes all the cattle near the door are standing with their heads away from the platform, and it is not easy to get them turned around. Not infrequently the first one, in attempting to back out of the car, pushes away

the loose bridge, or steps off one side of it, if too narrow or placed askew, and gets his leg down between the car and platform. He may indeed recover and get off with a slight scratch and trifling bruise; but the chances are that he will have to bear a painful injury till he reaches his destination at the shambles, when he will be terribly avenged by giving a fevered and diseased carcass to the market.

The bridges at the best, so far as I have observed, are quite loose, not hooked or clamped in any way to the car, and are very easily displaced. In some cases those in use were made originally for doors of less width than are now generally used; and too often they are worn or broken, made narrower by having pieces split off their sides, riddled with dangerous holes, and rendered unsafe by the loss of the cleats required to prevent slipping.

The animals, in general, take their places in the cars with admirable docility and promptness, and seem eager to get in to escape the too-ready prick of the goad, which the drivers (*toucheurs*, "touchers," the French call them), even when not intentionally cruel, apply oftener than necessary, and, by predilection, to the tender skin of the flank in front of the hip.

And here, perhaps, as well as elsewhere, I may say what I have to say about the goad. This implement in some form appears to be absolutely necessary, and when suitably constructed, entirely unobjectionable, although its unnecessary use should always be scrupulously avoided. The object of it is to prompt and accelerate the movements of the animals and produce instant obedience by a sharp, stinging prick, or the apprehension of such an admonition, which is just as efficacious as its administration after a few touches. No great length or size of spur is required for the utmost efficiency, as the finest point, of just sufficient length to pass through the hair and the epidermis and reach the surface of the true skin, will touch a nerve and give a momentary sensation of pain, as transient as the irritation of a fly's foot, but certain to be instantly obeyed. For this purpose a quarter of an inch in length, no larger than a large needle,—of just sufficient strength, in fact, to avoid the inconvenience of frequent breaking, and quite sharp at the point, inserted in a light staff or wand no bigger than a whip-stock,—is quite sufficient.

Something like this is often found in the hands of men about the yards. But in some cases, and notably at Chicago, the drivers are armed with long, heavy poles, much like the "setting-pole" used on canals, sometimes eight or ten feet long, and nearly two inches thick at the spear end, with a spear-head,—I can call it nothing else,—projecting an inch and a half, and not less than half an inch through at the base. A similar spear-point, a little less in length, projects from one side at a few inches from the end, the marks of which are seen in long scratches on the sides and haunches of luckless animals, and remain as a permanent injury to the hides. Standing upon the fences inclosing the yards, which are provided with firm and convenient running-boards, the drivers and men employed about the grounds use this formidable weapon with the prowess and zest of *picadores*, and inflict severe wounds.*

Such wounds are as useless as they are cruel. The immediate pain, or apprehension of pain, which is all that it is useful to inflict, is scarcely greater than from a touch which makes no puncture and leaves no wound, since the nerves are far less numerous in the muscles than in the skin.

But the deep puncture leaves a wound which is incurable in the low condition and excited nervous state of these animals during the few days of life remaining to them; and the result is a running sore or ulcer which it is revolting to contemplate.

It is undoubtedly true that herds of cattle, gathered quite wild upon the savannas, plains and prairies, never subjected

* The subjoined letter from John Cummings, Esq., President of the Board of Trade of the city of Boston, will be read with interest in this connection:—

BOSTON, MASS., Oct. 16, 1874.

J. C. HOADLEY, Esq. *My Dear Sir*,—In reply to your inquiry regarding the loss caused by transporting live cattle in cars from damage to their hides, I would say that I have for a long period used the hides from such cattle. I have annually used from thirty to forty thousand hides, the value of which to me has been lessened by holes punched in them, and by scratches on the grain, at least fifty cents each. This loss is mainly owing to the waste of leather arising from this cause. * * *

Nov. 4. I have just obtained the number of cattle brought to the Brighton market the last year, and find it to be 167,730.

Most truly yours,

JOHN CUMMINGS.

What an aggregate of suffering, for the most part needless, does this suggest! What nameless dangers to the health of the consumers of meat from animals so lacerated!

to the care of man save to pass under his branding-iron, or to feel his mutilating-knife or his marking-knife in the dew-lap, and just setting out on their long journey, are less easily managed than they become at a later stage. Some degree of violence is necessary to tame them and teach them to obey.

Unquestionably, some degree of self-control is exercised by the men who yield these formidable lances. It is needless to say, that the animals pierced and lacerated by them at any one time are few in number compared with those which pass unharmed.

But passing through many successive yards, and at least twice running the gauntlet of the spears at each yard, in unloading and reloading, and often in moving from one inclosure to another, they become like the veterans of many battles, save that their injuries do not have opportunity to heal, and for scars they show fresh or suppurating wounds. There can be no sufficient reason for allowing the use of so terrible a weapon, since the comparatively harmless spur is to the full as efficient.

It cannot be too strongly stated, nor too often reiterated, that whatever treatment is injurious to the health and comfort of the living animal, is prejudicial to the quality of his flesh as food, and hurtful and dangerous to those who eat it.

Even terror, although of no long continuance, such as that resulting from witnessing the slaughter of other animals, or the smell of fresh blood, or receiving with uncovered eyes several successive blows of an axe before there falls one of sufficient force, with well-directed aim, like the fist of Entellus, to produce insensibility by concussion of the brain, may perhaps affect the flesh by alteration of the secretions, and may, it is said, in some cases render it absolutely poisonous.

Humane methods of slaughtering are not our present theme, but this subject is here referred to as an illustration of the pernicious effects of violence and abuse during the journey to market.

Undoubtedly these ill effects would pass away after a longer or shorter period of rest and generous feeding, but this cattle rarely get, although nothing can be more urgently demanded by every consideration of public health and safety. Do what we may to ameliorate the conditions of travel, they can

never arrive at the market in perfect condition for the abattoir. They must, of necessity, be more or less fatigued, impoverished, excited and disordered, and there should always intervene a period of rest and careful feeding and attendance, to bring them back to perfect condition before they should be allowed to go to the shambles. If too far gone with disease or exhaustion to be brought back to healthy life, their use for food should be carefully and effectually guarded against, at whatever cost. If, although less exhausted, they do not immediately thrive, they should be *therefore* kept until they do, for only when gaining, or at least holding their own, can their flesh be in the best state for food. I cannot estimate the effect of such a quarantine upon the cost of meat in our market. Sagacious butchers in smaller cities, as, for instance, in Manchester, N. H., find their account in buying cattle several months in advance of their requirements, and feeding them in fresh pastures during the season and in warm sheds in winter, the gain in weight affording a profit on the cost of feeding.

Perhaps in the vicinity of Boston the vast herds which would require such care could not obtain it at admissible cost; but something in this direction should certainly be done, and enforced by appropriate laws and efficient inspection.

The very worst phase of the present system, perhaps, is the mode occasionally adopted of removing cattle from the cars fifty miles or more before they reach the market, and driving them the remainder of the way, with little rest and no food, save such as they can crop by the dusty roadside as they go. Such hardly-entreated animals set out on this death-march already fatigued, famished and weakened by a journey of days or weeks in the cars, and they arrive wearied, foot-sore and fevered, with the last ounce of available vitality sucked out of their juiceless fibres, and are fit only to avenge upon society, through such of its members as may have been guilty only of apathy,—but, being guilty of that, guilty of all,—the cruel hardships to which they have been subjected.*

* Mr. J. Battersby of Albany, of fifty years' experience in business as butcher, says, that he keeps all cattle received from the West from three to six days, till they eat well, and get entirely rested; and that if slaughtered immediately, their flesh is feverish, and not wholesome food.

To this practice, the proposed period of rest, refreshment and inspection before slaughtering would put a stop or supply a remedy. Cattle might still be driven to market, and and suffer by the journey, but they would have to be brought again into condition before they could find their way to the stalls of our markets.

Until something like this is done, we shall always be liable to spend our money for that which is not *meat*, "and our labor for that which satisfieth not," and to find in the costly viands on our tables, instead of the refreshment and vigor we have a right to expect, if not virulent disease and sudden death, at least the seeds of maladies which result from IMPERFECT NUTRITION.

TRANSPORTATION OF SWINE, SHEEP AND HORSES.

Transportation of Swine.

This branch of our subject will call for no extended remark. The disposition and temperament of these animals adapt them well to transportation. It was the saying of a railway official of large experience and keen observation, whose pithy comments I have more than once had occasion to recall, that "a hog is the best of travellers, and altogether the most serene, contented and happy being connected with a railroad in any capacity." They do best when pretty closely packed, as they are then more quiet, and are less likely to crowd together, one on top of another, for warmth in cold weather. Great mortality sometimes arises from this cause, and, strange to say, oftenest in roomy yards, where there seems to be no reason for it save the attraction of warmth, which leads those still standing to lie down upon such as are already lying down, until those at the bottom of the heap are stifled for want of air.

They would suffer greatly from exposure to the sun in summer, but their pens are almost always covered, and the cars also afford them shelter.

Their own fat provides abundant aliment to keep up their animal heat; and their quiet, inactive temperament, calls for but small quantities of food to supply the waste attending muscular exertion. It is now the common practice to wet them at all stopping-places during warm weather; and if this is ever neglected it should be enforced in all cases.

The greatest injury they sustain is from fighting among themselves; and this is chiefly done when unloaded for feeding and watering, and while the cars are standing still. The motion of the cars appears to quiet them, and the higher the speed the sooner do they subside into repose, and the more contented do they remain. A train of twenty-five cars loaded with hogs, swept past me at thirty-five miles an hour, a few miles out of Chicago, and almost all the animals were lying down and all were quiet. There was no fighting among them.

They sometimes slip and spread their hind-legs apart, causing great injury to the hams and doubtless severe suffering to themselves; and so far as this accident is due, as it too often is, to ill-arranged and defective landings and bridges, it should be carefully guarded against. The danger is greatest in wet and icy weather, and would be far more serious than it is were not the passages generally under cover. Messrs. John P. Squire & Co. were obliged, on account of the impossibility of obtaining land suitably located adjacent to the railroad, to build their new and excellent swine-sheds, at Buffalo, at a little distance from the loading platform. The passage is planked and every precaution is used, but the distance is unfavorable, and some injury, it is said, arises from this slipping and spreading. The pens, yards and passages are kept admirably clean; all litter is swept out and carted away after each occupancy; not a barrow-load could be gathered from the entire premises.

It seems to be conceded on all sides, that in the case of these animals, pretty long stages and high speed—with frequent wetting in warm weather and good and sufficient bedding in winter—are not only harmless but beneficial, as they are quiet while in motion, and receive their principal injury in loading and unloading, and by fighting in their pens.

High speed is doubly important with them, as their journey is thereby shortened and rendered more quiet while it lasts.

The law of the United States should be modified, so far as it relates to swine, as there is no doubt that a journey of thirty-six hours without unloading will cause them less injury

and less suffering, than more frequent stops for food and water. Rest they get in the cars.

This business has grown to very large proportions within a few years. Some statistics concerning it will be found in succeeding pages.*

Transportation of Sheep.

The sheep-folds at Buffalo and Albany, as will be described,† are admirable, apparently perfect. The small and nearly uniform size of these animals, their gentle, inoffensive nature, and the soft bed afforded by their own fleece, unless recently shorn, all conspire to make railway transportation remarkably free from discomfort for them; and since human beings, with all possible appliances of luxury and ease, can hope for no more than not to be intolerably uncomfortable on a journey by rail, so much ought to suffice for sheep.

It is said, however, that they are the most difficult animals to handle of any that are transported by rail. Sometimes, for no apparent reason, they will all huddle together at one end of a car by no means crowded, by which means one or more will be suffocated. It is said that the deaths from this cause among the sheep received at Brighton will average one to a car-load, which may be called one per cent. For this it is not easy to point out a remedy, as long as sheep remain "silly"; *but overcrowding can be and should be avoided.*

Abuses and avoidable hardships, if they exist, as they doubtless do to some extent, must be exceptional and occasional, not the faults of the system, save inasmuch as the system does not include efficient inspection by competent men acting in the interests of society, of humanity, and of the animals.

Transportation of Horses.

This subject, although in terms included in our theme, is really foreign to the matter with which we are here chiefly concerned, which is the transportation of animals destined for the supply of our markets, considered with regard to the public health and the public morals, and also as a question of

* See p. 112, *et seq.*

† Pages 126, 127.

cost, all things being taken into account,—shrinkage, loss and deterioration.

The fine qualities of this noble animal procure for him more consideration and better treatment than is generally afforded to the patient bovine race, to silly sheep and sluggish swine. It is common to see the upper part of their tails tied up in canvas, and this protection afforded to the hair extends also to the skin which would otherwise suffer, as in horned cattle, by painful abrasion.

I cannot speak with much assurance on the subject, but I derived the impression from inquiry and some observation, that while they may sometimes undergo avoidable suffering and privation, the general attention to their necessities, wants and comfort is reasonably satisfactory. But here, as elsewhere, faithful inspection would do no harm, although it must be admitted that it is not imperatively called for as it is in the case of beef (whether dressed or on the hoof), sheep and swine.

BOSTON LIVE-STOCK MARKET.

TABLE I.

Number of car-loads of cattle during the year 1873, . . .	9,912	
Mean number of cattle to each car,	16.92	
Mean weight of each car-load,	22,375	lbs.
Mean weight per head,	1,322	lbs.
Number of cars in 1873 containing 12 to 16 head per car, . . .	7,862	
Mean aggregate weight per car-load,	22,400	lbs.
Mean weight per head,	1,401	lbs.
Number of cars containing 17 head per car,	411	
Mean aggregate weight per car-load,	22,525	lbs.
Mean weight per head,	1,325	lbs.
Number of cars containing 18 head per car,	388	
Mean aggregate weight per car-load,	22,508	lbs.
Mean weight per head,	1,250.5	lbs.
Number of cars containing 19 to 20 head each,	349	
Mean aggregate weight per car-load,	22,325	lbs.
Mean weight per head,	1,145	lbs.
Number of cars containing 21 to 22 head per car,	332	
Mean aggregate weight per car-load,	22,050	lbs.
Mean weight per head,	1,025.5	lbs.
Number of cars containing 23, 24 or 25 head,	291	
Mean aggregate weight per car-load,	22,800	lbs.
Mean weight per head at 24 per car,	950	lbs.

Graphic Representation

Showing the Number and weight of the several grades of Cattle received at the Boston Live Stock Market in the year 1873. Mean weight per head of each grade, and ratio of the number of each grade to the whole number.

Cattle — 1873.

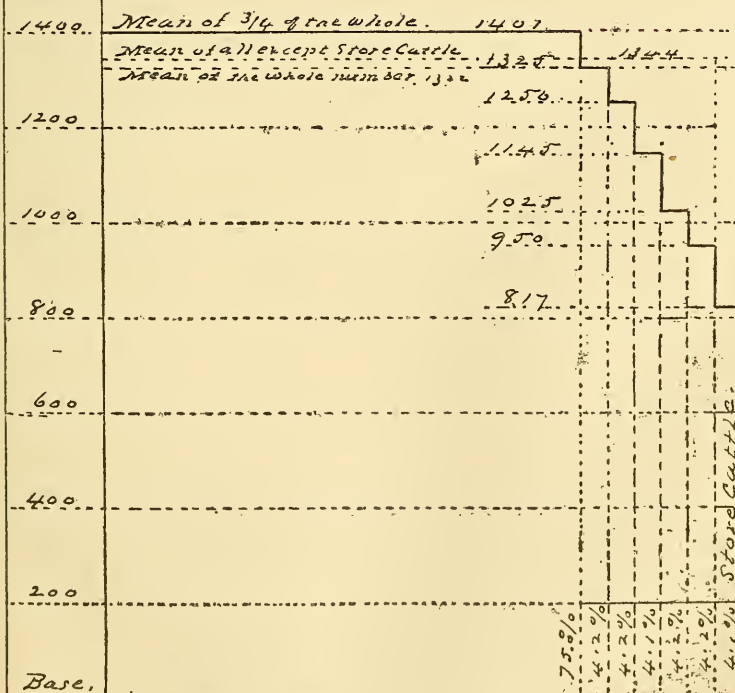


TABLE NO. II.

Showing all the Animals received at the Boston Live-Stock Market, annually, for Thirteen Years, 1862-1874.

Y E A R S .	Beef Cattle.	Veal Calves.	Sheep and Lambs.	Fat Hogs.	Shoats and Pigs.
1862, . . .	98,218	10,000	229,198	55,000	46,000
1863, . . .	110,815	16,005	250,597	68,891	22,950
1864, . . .	108,836	16,570	302,350	53,372	15,759
1865, . . .	117,866	17,795	341,331	70,329	29,108
1866, . . .	118,185	10,205	431,218	84,909	26,210
1867, . . .	107,866	12,387	411,940	96,401	10,274
1868, . . .	110,009	13,380	493,085	127,550	10,443
1869, . . .	129,353	13,000	413,404	145,200	23,818
1870, . . .	124,592	16,000	450,997	168,802	20,528
1871, . . .	129,247	13,230	487,065	338,027	13,280
1872, . . .	157,366	17,852	412,217	592,727	9,298
1873, . . .	167,730	19,358	414,026	838,203	16,304
1874, . . .	163,311	17,670	363,488	561,937	26,324
Totals, . .	1,643,394	193,452	5,000,916	3,201,348	270,296
Means, . .	126,415	14,881	384,686	246,258	20,792
1862, '63, '64, .	105,956	14,192	260,715	59,088	28,236
1872, '73, '74, .	162,802	18,293	396,577	664,289	17,309

NOTE.—The diminished number of shoats and pigs in ten years, while the population has largely increased, probably reflects the decline of the habit of keeping domestic animals, already referred to.

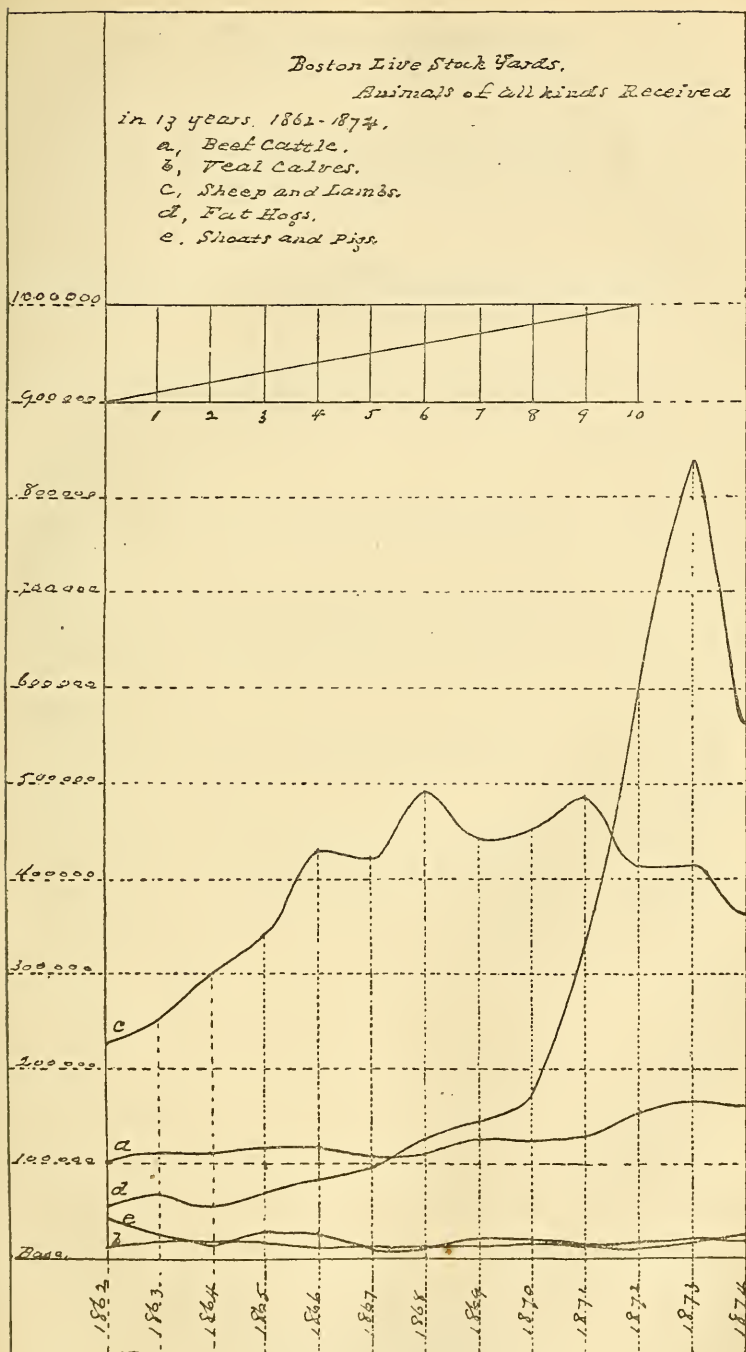


TABLE NO. III.—Showing the number of head of Beef Cattle from the several sources of supply, for each year for *Thirteen Years, 1862–1874.*

Y E A R S .			Massachusetts.	Maine.	New Hampshire.	Vermont.	Northern New York.	The West, including Albany.	Canada.	Total.
1862,	.	.	3,660	12,502	9,958	31,206	3,602	35,405	1,885	98,218
1863,	.	.	4,436	20,266	15,165	28,481	3,365	34,944	4,158	110,815
1864,	.	.	6,064	10,292	13,213	33,353	5,951	37,666	2,297	108,836
1865,	.	.	4,933	11,256	9,509	31,020	8,402	38,233	15,413	117,866
1866,	.	.	2,925	9,879	5,496	20,533	4,768	68,661	5,923	118,185
1867,	.	.	2,365	9,079	5,957	19,438	4,411	63,059	3,557	107,866
1868,	.	.	2,780	10,574	7,209	18,426	4,327	61,688	5,005	110,009
1869,	.	.	2,283	10,792	6,084	13,966	4,156	87,421	4,651	129,353
1870,	.	.	2,018	19,267	8,248	17,191	4,462	64,979	8,427	124,592
1871,	.	.	1,336	16,505	5,224	12,922	1,915	88,079	3,266	129,247
1872,	.	.	1,734	2,992	5,336	21,720	5,323	115,306	4,955	157,366
1873,	.	.	1,589	942	2,767	14,850	5,816	138,878	2,888	167,730
1874,	.	.	789	4,514	4,837	10,856	4,045	136,737	1,533	163,311
Totals,	.	.	36,012	138,860	99,003	273,962	60,543	971,056	63,958	1,643,394
Means,	.	.	2,770	10,681	7,616	21,074	4,657	74,697	4,920	126,415
Means for 1862, 1863, 1864,	.	.	4,720	14,353	12,779	31,013	4,306	36,005	2,780	105,956
“ “ 1872, 1873, 1874,	.	.	1,371	2,816	4,313	15,809	5,061	130,307	3,125	162,802

TABLE No. IV.—*Showing the Number of Sheep and Lambs received annually from each of the several sources of supply, for Thirteen Years, 1862-1874.*

Y E A R S.		Massachusetts.	Maine.	New Hampshire.	Vermont.	Northern New York.	The West, including Albany.	Canada.	Total.
1862,	.	14,878	31,169	22,946	95,495	11,846	20,927	31,937	229,198
1863,	.	18,543	32,723	35,060	91,614	16,992	19,575	36,090	250,597
1864,	.	29,882	28,117	40,463	99,284	21,227	57,326	26,051	302,350
1865,	.	16,892	24,491	37,913	123,457	36,341	26,959	75,368	341,331
1866,	.	24,348	27,039	50,241	204,004	40,144	55,999	29,443	431,218
1867,	.	15,390	14,137	46,696	165,478	28,068	105,695	36,476	411,940
1868,	.	18,300	9,174	41,965	173,802	39,733	167,410	42,701	493,085
1869,	.	14,998	10,494	39,638	125,826	35,809	132,524	54,115	413,404
1870,	.	12,785	10,821	38,874	145,315	49,587	100,471	93,144	450,997
1871,	.	14,019	19,878	43,542	115,721	43,680	150,849	99,376	487,065
1872,	.	13,528	6,667	23,308	80,861	31,258	167,479	89,116	412,217
1873,	.	17,750	4,243	26,373	87,716	44,288	172,308	61,348	414,026
1874,	.	8,981	14,111	29,151	65,893	47,410	151,615	46,327	363,488
Totals,	.	220,204	233,064	476,170	1,574,466	446,383	1,329,137	721,492	5,000,916
Means,	.	16,939	17,928	36,629	121,113	34,337	102,241	55,499	384,686
Means for 1862, 1863, 1864,	.	21,101	30,670	32,823	95,464	16,688	32,610	31,359	260,715
“ 1872, 1873, 1874,	.	13,420	8,340	26,277	78,157	40,985	163,801	65,597	396,577

TABLE NO. V.—*Cattle shipped to Boston from Chicago in Refrigerator Cars, Monthly, in the year 1874.*

[WEIGHT OF DRESSED BEEF.—The aggregate for the year is from the books of the Company. The monthly aggregates are computed from live weight, by established ratios.]

MONTHS.	No. of Car loads.	Number of Head of Cattle.	Mean Live Weight, each—pounds.	Aggregate Live Weight, monthly—pounds.	Per cent. of Dressed Beef to Live Weight.	Estimated Weight of Dressed Beef, monthly—pounds.	Mean Weight of Beef per Car load—pounds.
January, .	42	838	1,340	1,122,830	58.50	656,856	15,639
February, .	26	698	1,377	956,400	58.64	560,833	21,571
March, .	38	1,005	1,388	1,394,560	58.68	818,328	21,535
April, .	43	1,102	1,382	1,523,370	58.66	893,609	20,781
May, .	53	1,085	1,366	1,481,840	58.60	868,358	16,384
June, .	50	1,380	1,349	1,861,900	58.54	1,089,956	21,799
July, .	39	1,018	1,335	1,359,440	58.48	795,001	20,385
August, .	55	1,364	1,248	1,702,210	58.02	987,622	17,957
September, .	52	1,745	1,222	2,132,540	57.89	1,234,527	23,741
October, .	58	1,499	1,227	1,838,610	57.94	1,065,291	18,362
November, .	56	1,707	1,336	2,279,760	58.47	1,332,976	23,803
December, .	50	1,139	1,280	1,458,650	58.18	848,643	16,973
Aggregate, .	562	14,580	1,311	19,112,110	58.35	11,152,000	—
	—	—	—	—	58.63	11,206,270	19,940

It will be observed by the diagram on p. 113, that a rise in the line representing the number of sheep per annum is in general associated with a depression of the line representing the number of cattle, and *vice versa*.

For instance, the line of sheep, 1866 to 1872, is convex upwards; that of cattle for the same period of time, convex downwards. In 1868, the cattle line is low, the sheep line high. In 1869, sheep fall, cattle rise; in 1870 and 1871, sheep increase, cattle decrease; in 1872 and 1873, sheep fall off, cattle more than make good the deficiency.

In one respect, the comparison of these two lines is deceptive, or rather, stands in need of correction. The lines both represent numbers of animals; and twenty sheep are only equal to one bullock.

Whosoever examines Table No. I. with care, will be impressed with the evidence it affords of the extremely liberal and exceptionally good quality of the beef supplied to our markets. The detailed statement for the year 1873, shows

that exactly three-fourths of the number of cattle, constituting eight-tenths of their weight, weigh over 1,400 pounds each, less than sixteen forming a car-load.

Again, seven-eighths of the whole number, aggregating 91 per cent. of the total weight, have an average weight of 1,372 pounds, averaging sixteen and a quarter to a car; while the whole number received (after taking out "store-cattle," two-year-olds and yearlings), 96 per cent. of the total number, and more than 97 per cent. of their weight, show a mean weight per head of 1,344 pounds, and a mean number of sixteen and two-thirds to a car-load. These are heavy cattle, although many of them of course fall much below the average. The lowest mean weight of any class, admitted to this last statement, is 950 pounds, and this grade forms but a little over four per cent. of the total. Included in the first, or highest grade, which constitutes three-fourths of the whole, are many very heavy cattle, weighing 1,500, 1,600, 1,700, 1,800 and over, for which there is a large and constant demand. Many of the finest come from the valley of the Connecticut, where they are raised and fattened for the sake of the manure they yield to the tobacco-fields. Nearly all the comparatively small number of cattle from "Massachusetts," come from this source, and their value is relatively much greater than their number.

Besides the animals brought alive to our market, there is a very important addition in the quantity of dressed beef, brought principally from the West, and largely from Chicago, forming not less than one-ninth of our whole supply, and carrying up the total to the equivalent of 20,000 head per annum for 1873 and 1874. The quality of this dressed beef ranges from very good to very vile. Much of that brought in the winter in open cars, can only be regarded with extreme suspicion, often deepened to extreme aversion. The low price at which it is offered, as low as four cents per pound, while it may tempt the poor, the thoughtless, the penurious and the unscrupulous, is sufficient to condemn it in the eyes of all who can form an intelligent opinion.

Only cattle of the very lowest grade, poor and wasted to the limits of bovine endurance, can be bought at such a price in Chicago,—less than two cents per pound,—as to permit

the sale of their carcasses in Boston at four cents; and what this grade of cattle is may be learned from the extract from the "Drover's Journal" in the note on p. 94.

Nor is this the worst, since there is no reason to doubt that among cattle so emaciated, all forms of disease which are developed and aggravated by imperfect nutrition, prevail to a great extent, or that among them are many which are in the last stages of disease.

This class of dressed beef should be carefully watched, inspected both here and at the place of shipment, and in case of real danger, warning, at least, should be given to the community against its use.

The other class,—which has nothing in common with the above, save the single fact that it is dressed at a distance and brought to our market in the quarter,—comes in refrigerator cars.

NOTES AS TO THE QUALITY OF BEEF CATTLE,

FROM THE SEVERAL "SOURCES OF SUPPLY," AND BY DIFFERENT "ROUTES."

Massachusetts.—Almost entirely from the Connecticut River Valley, about Greenfield. Quality excellent; generally large, heavy cattle, weighing from 1,400 to 1,800 pounds, and, *therefore*, what butchers call "good," whether really so or not; and almost of necessity little injured by fatigue and starvation in transit, being close by, and *therefore* really good,—*excellent*, whether heavy or light, fat or less fat,—unwasted, unsqueezed; *not* like the beef after making beef-tea, such as results from starvation.

Maine.—Most of the "store cattle," yearlings and two-year-olds, come from Maine. These are all, or nearly all, included in the lightest grade in 1873; 817 pounds mean weight; 25 and over to the car. But Maine sends, also, some fine cattle, and at times some very poor. The severe drought a few years ago, caused the shipment to market of cows, oxen, cattle of all kinds, mostly poor. Then the supply fell off, and has been almost nothing until last year, when it revived in some degree. The Maine supply is almost uninjured in transit.

New Hampshire.—Sends us many excellent cattle, and some small and light; but all are uninjured, or comparatively so, by travel.

Vermont.—Much like New Hampshire, but more important to us, because the supply is larger. Some of our heaviest beef comes from Vermont, and it all belongs to our "home supply," being within the circuit of short transit.

Northern New York.—Much as New Hampshire and Vermont. These cattle come to us instead of going to New York City, on account of the facilities for transportation,—although New York's need is as great, on the whole, as that of Massachusetts.

Canada.—Taken here, out of its turn, because belonging to our "home supply," and coming without destructive shrinkage, by starvation and fatigue. Some of the very finest beef ever seen in Boston (and therefore equal to any), comes from Canada,—from the Stanstead Plains. Some poor, *i. e.*, not fat beef, comes also. On the whole, the quality is good, whether fat or not.

Home Supply.—New England, New York and Canada: About one-sixth of our supply (but less, if we take out store cattle, which are kept a year or two before slaughtering,—4.1 per cent. out of 16.3 per cent., leaving 12.2 per cent., or less than one-eighth,—say one-eighth instead); but vastly more than one-eighth in *value*: first, because above the mean weight per head; and, second, because it is unwasted, and therefore of *full* value.

The West.—Albany is included, because nearly all the cattle bought there for our market have already been brought from several hundred to several thousand miles,—sometimes two thousand miles,—and are of the same quality as all the other Western cattle,—originally good, bad or indifferent,—but mostly originally good.

The supply by refrigerator cars is now a very little less than that from Massachusetts, Maine, New Hampshire, Vermont,

Northern New York and Canada, all combined; and taken with these sources, goes to constitute about 21 per cent., or over one-fifth of our supply.

As to Railroads, etc., bringing our Supplies.

Boston & Albany.—Brings from the West, and in part from the Connecticut Valley.

Eastern.—Brings from Maine.

Lowell.—Brings from Vermont and Canada.

Fitchburg.—Brings from Vermont and Canada, from Deerfield, Mass. (Connecticut River Valley), and from the West. If any animals come from Canada by this route, they are all credited to "The West," and they are few.

By Boat.—Animals come from Bangor, Maine.

On Foot.—Cattle mostly from our immediate neighborhood.

STOCK-YARDS.

In no way, perhaps, can one obtain so clear an idea of the magnitude of the cattle-trade, of the enterprise, capital, capacity, and skill employed in conducting it, of the improvements already made, and of the abuses to which it is still liable, as by carefully studying it in the great stock-yards on the long routes from the West, the South-west and the South, to the great markets on the Atlantic.

My own observations extend only to the stock-yards at Chicago, Buffalo, Albany, Brighton and Watertown. These yards were selected for examination because, in the few weeks at my disposal, it was necessary to confine my attention chiefly to a single route, and the route here indicated seemed as important as any to the supply of our markets.

The new yards at St. Louis are said to be convenient, well arranged, and well managed, and I regretted my inability to visit them. It is quite likely that they excel in some particulars, since they are among the newest; and the rule holds pretty generally good that the latest show certain improvements upon those of earlier date.

The Union Stock-Yards, Chicago.—These fine yards are owned by a company incorporated under the laws of Illinois, by special charter, in 1864, with a capital of \$1,000,000, of which amount \$925,000 was subscribed by nine railway companies. They were commenced in June, 1865, and opened for business in December of the same year. Their territory comprises three hundred and forty-five acres, of which more than one hundred and twenty are now occupied by pens, and the streets and lanes communicating with them; forty-seven acres are set aside for the hotel and other buildings, and one hundred and seventy-six are reserved for new pens. Twenty-one miles of railway connect the yards with all the important railroads centering in Chicago, and by skirting three sides of the space covered by pens far enough from their borders to afford double frontage, furnish great facilities for receiving and shipping animals of every description usually transported by rail. Two artesian wells, one of them one thousand and thirty-two feet in depth, the other eleven hundred and ninety, furnish an abundant supply of excellent water, always flowing into capacious and accessible troughs, to which all animals within the yards have free access. Thirty-five miles of drains carry off the surface water; ten miles of streets give access, by means of over three thousand gates, to over two thousand open pens for cattle, one thousand covered pens for hogs and sheep, and to stables containing stalls for three hundred and fifty horses. The yards have capacity for twenty-seven thousand head of cattle, one hundred thousand hogs, and fifty thousand sheep. A large hotel, the "Transit House," fully up to the requirements of its public, where can always be found what cannot always be obtained elsewhere in Chicago,—as good beef as can be got in Boston or New York; a fine range of buildings for the officers of the company and of persons engaged in the trade; a national bank, affording all needful facilities for transacting the large financial business of the market; and a newspaper, "The Drover's Journal," constitute, altogether, a very complete equipment.

Receiving pens equal in length to an ordinary car, about 30 feet, and of suitable width to give ample room to a car-load,

are ranged along the platforms, and communicate on the other sides with lanes leading by a system of streets, lanes and gates, to the weighing-scales, and to the feeding and storing yards.

These are of somewhat various forms and dimensions, but are generally about equal to 100 feet square, or 10,000 square feet, say a quarter of an acre, and afford a space equal to ten feet square to each of the one hundred cattle,—four or five car-loads,—usually put into them at once.

Of the watering-troughs with which they are all supplied, I have already spoken. Feeding-troughs, or mangers, extend around three sides of each yard, affording about three feet in length to each animal, and are profusely supplied with good hay. Col. John B. Sherman, the energetic superintendent of the yards, told me that their rule was to supply twenty pounds of hay per head every twelve hours,* and the appearance of

* Neat-cattle require, to keep them in good health, of good hay, one-sixtieth of their own weight, and, for full feed, twice that quantity, or one-thirtieth of their own weight; or an equivalent quantity of other food (MM. Moll et Gayot, "Connaissance General du bœuf," p. 45, as cited by M. Auguste Zundel, *Améliorations à apporter au mode de transporter des animaux par les chemins de fer*, pp. 32, 33; Paris, 1870). As to the "equivalent quantity of other food," M. Zundel sets it, for oats, at half the weight of hay, remarking that oats are digested by animals of the bovine race even better than by horses, as the lignin, or cellulose, is to a greater extent reduced to an assimilable form by their longer and slower digestive process.

The following analyses of hay—for which, with the references, I am indebted to Dr. H. P. Bowditch—are here inserted for reference, as they are not, I find, very generally accessible:—

ANALYSIS OF HAY, BY STOHRMAN.

	1st.	2d.
Albumen,	10.69	9.94
Cellulose,	27.21	24.08
Fat,	2.99	3.96
Non-nitrogenous extractive matter,	50.07	54.73
Ashes,	9.04	7.29
	<hr/> 100.00	<hr/> 100.00

These specimens must have been dried previous to the analysis, since they contain no water, which must have formed fourteen to fifteen per cent. of their weight in ordinary commercial condition.

The albumen and fat are nutritious,—the fat more so than the albumen, in the ratio of 2.4 to 1. Of the cellulose, an indefinite and probably variable proportion is digested,—a larger proportion, probably, by ruminating animals than by horses.

The extractive matter is probably only another form of expression for residuum of indeterminate character, save that it is soluble in water. The ashes are non-nutritive.

In the "Zeitschrift für Biologie," vol. VI., p. 218, a number of analyses of hay will be found, but nothing more definite than the above.

the yards indicated as much, being abundantly littered with fresh hay, carried by the cattle away from the mangers, and dropped profusely on the ground.

The fences are boarded on both sides of the posts with horizontal strips placed a few inches apart; and a capping of wide, strong plank securely fastened on top affords a good walk around the yards. The only drawback is the necessity of descending at each of the numerous gates,—an incon-

The following analyses of oatmeal and Indian-meal are from Carpenter's "Animal Physiology," § 164, where they appear in a table with other articles of food :—

	Water.	Albuminous substances.	Starch, sugar, etc.	Fat.	Salts.	Carboniferous.*	Nitrogenous.	Total nutriment.
Oatmeal,	15.0	12.0	62.	6.0	3.0	76.4	12.0	88.4
Indian-meal,	14.0	9.0	65.	8.0	1.7	84.2	9.0	93.2

* "The value of the fat is stated in this column according to its *heating* equivalent of starch, which is larger in the ratio of 2.4 to 1. Hence, in the last column, the proportion of nutriment in aliments containing fat comes to be greater than the weight of their solids would indicate."

The following analyses—drawn from "How Crops Grow," by Professor S. W. Johnson, of the Yale Scientific School—are by Wolff and Knop (Knop's "Agricultur-chemie," 1868, pp. 715, 720) :—

SUBSTANCES ANALYZED.	Water.	Organic matter.	Ash.	Albuminous substances.	Carbo-hydrates.	Crude fibre.	Fat.
Meadow hay, medium quality, .	14.3	79.5	6.2	8.2	41.3	30.0	2.0
Timothy,	14.3	81.2	4.5	9.7	48.8	22.7	3.0
Oat straw,	14.3	80.7	5.0	2.5	38.2	40.0	2.0
Wheat straw,	14.3	80.2	5.5	2.0	30.2	48.0	1.5
Oats,	14.3	82.7	3.0	12.0	60.9	10.3	6.0
Maize,	14.4	83.5	2.1	10.0	68.0	5.5	7.0

The "ash" is equivalent to the "salts" of Carpenter; the carbo-hydrates include fat, starch, sugar, pectin, etc.; "crude fibre" is impure cellulose, or woody fibre; "fat" includes fat proper, wax, chlorophyll, and, in some cases, resins. Columns 1 + 2 + 3 = 100. Column 2 = columns 4 + 5 + 6, except in the case of oats, where there is a slight discrepancy (perhaps the 60.9, in column 5, should be 60.4: this is conjectural).

It would appear, from an examination of these tables, that the practical rule for the nutritive value of oats—twice that of an equal weight of hay—is not far wrong; but ruminating animals require, as a part of their food, hay, straw or grasses having long fibres, to afford a basis of rumination.

venience obviated in some other yards by plank bridges, slightly raised, over the gates.

The yards, pens, and lanes are floored with plank, and, being generally covered with two or three inches of litter, largely composed of clean hay, are comfortable in good weather, but rather slippery in the wet.

After two or three hours, having eaten all they desire, plenty of hay being still left in the mangers, the cattle lie down, for the most part, and ruminate with the air of placid enjoyment characteristic of their race, and present a perfect type of rest, contentment and peace.

But few of the cattle-yards here are furnished with sheds. To suggestions on this subject the reply is, that few of the cattle received at Chicago have ever seen any shelter whatever, even that of a tree, and cannot require sheds. Yet there can be little doubt that during a large part of the year the protection which sheds would give from rain, snow and chilling winds, and from the sun, would greatly promote their comfort and health, reduce the consumption of food and improve their condition.

Cows are generally kept apart from other cattle, and, as they are comparatively few in number at most seasons of the year, they are placed in smaller yards, often in sheds. Calves and young animals are also kept apart from animals fully grown.

Cows with sucking calves are placed in distinct compartments, and not unfrequently the playful gambols of the calf and the natural solicitude of the cow were pleasantly suggestive of country farm-yards, and would grace a pastoral after the manner of Gay.

On the whole, an unmistakable air of comfort, contentment and well-being pervaded the place, which not even the feeling that bad weather would alter it for the worse, could quite destroy.

The pens for swine are roofed, and tolerably well kept. The platforms, with double stages to correspond with the double decks of the cars, for loading and discharging, are safe and commodious. The supply of food and water is ample.

The sheep-folds are spacious, airy, well arranged and convenient, and, although less conspicuously clean and attractive

than the new sheep-folds at Buffalo and Watertown, give no ground of complaint.

The great extent of these yards, and the vastness of the transactions which take place in them, make it necessary to drive the animals, especially neat-cattle, a considerable distance, from the receiving-pens to the feeding-yards, and back to the re-loading pens; and the time so taken up, often an hour or more, very materially diminishes the period allotted them for rest; the minimum duration of which is fixed by the United States law at five hours, after a maximum period of confinement of twenty-eight hours.

More time than five hours is generally allowed them at Chicago, I am told, and more should be required by law. Not less than five hours of entire rest should be given them in the feeding-yards, undiminished by driving to and fro.

The plan of removing cattle from the cars at stated periods, on long routes, for food, water and rest, known in Europe as the American plan, although highly commended for its humane intention, finds little favor among European authorities on the subject.

In the report of the committee of the House of Commons "On Noxious Businesses," a blue-book ordered by the House of Commons to be printed July 8, 1873, Mr. W. McCombie, a member of the House of Commons for the county of Aberdeen, west district, who had been fifty years in the cattle-trade, and who had taken prizes in money, cups and gold and silver medals, amounting in value to over £2,000, speaks, with great positiveness, thus: "If you allow those cattle to be all untrucked to be watered, what would be the consequence? They must be all mixed together, some of them heifers, perhaps, just coming in season, and many of the bulls very dangerous to handle." "What sort of a mess would it be altogether if the cattle were to be taken out of the trucks, as is proposed, and put all into one mass to feed and water them, and then put them in again? The thing is perfectly impracticable." "I have no objection to their being watered and fed, if it can be done without taking them out of the trucks. I should very much wish to see it, but the thing is perfectly impracticable, to take cattle out of the trucks and re-truck them again." Of the time from Aberdeen to London, he

says, "They profess to carry them in thirty-six hours, but they are often forty and forty-two hours, and, I believe, forty-four hours in the transit." And without food and water!

M. Auguste Zundel, in his admirable prize essay on the transportation of animals by rail, says, p. 34, "We should not advocate the American system, where the animals are discharged every twelve hours for food and water,"—giving us credit for greater solicitude for the comfort of these animals than we can lay claim to.

But it is obvious that such convenient and complete arrangements for discharging cattle, car-load by car-load, into distinct yards, for keeping them distinct, sorting or mixing at will, as are provided at our great stock-yards, are entirely unknown to Mr. McCombie, else his strong and reiterated declarations of the impracticability of our daily practice would have been withheld or modified. They are much like the equally positive assertions one hears in England, that our universal system of signal-bell on the locomotive, with the bell-rope running through the train, accessible to all the passengers, "will never answer."

The objections of Mr. McCombie are strong and valid enough against turning all the cattle of a stock-train loose in a single inclosure, but vanish entirely before the well-organized system of the Union stock-yards of Chicago.

The only thing suggestive of cruelty, or of needless injury to the hides or flesh of the animals to be seen at Chicago, is the use of the formidable goad or spear, of which I have already spoken.* Whatever may be said of the wildness and ungovernableness of many of the animals received there, nothing is to be gained by inflicting deep,—and, in their numbered hours,—incurable wounds.

Buffalo Stock-Yards.—These yards are nearly new, having been removed from a position nearer the city a few years ago, and are in many respects admirable. The fences are closely boarded on both sides of the posts, and are surmounted by a firm, broad walk, carried over the numerous gates by a slightly elevated bridge, so that an excellent view of all the yards may be obtained by walking around on the fences.

* See page 104.

The feeding and storing-yards are quite various in form and dimensions; but many of them are about seventy feet by one hundred and forty, with sheds on one or both of the long sides. The open space between the sheds is paved with cobble-stones, sloping towards a gutter in the middle, and this gutter pitches each way to a cess-pool at each end, communicating with underground drains.

The space under the sheds is floored with sand and loam, sloping towards the paved area, and affords comfortable standing-room, and lying-down room too, for that matter, to all the animals the yard is expected to contain. Water-troughs and mangers are placed under the sheds, and fully supplied, the troughs with excellent water from artesian wells, slightly saline, and much relished by the cattle, the mangers with hay of good quality, not quite so profusely, perhaps, as at Chicago, but sufficiently.

The swine-sheds are excellent, and the sheep-folds truly admirable. Racks filled with hay, mangers for grain, and flowing water-troughs, clean, roomy, well-floored pens, with every convenience for sorting, driving, receiving, shipping, and a sagacious old bell-wether to pilot them in,—all seemed so complete as to leave nothing to be desired. Similar houses are to be erected for swine.

Some statistics concerning the business of these yards, are given in a foot-note to page 81.

On Wednesday, September 23, 1874, there were shipped from these yards two hundred car-loads of beef cattle, and fifty-eight car-loads of hogs, sheep and horses.

Albany Stock-Yards.—These yards, also, were moved a few years ago to their present site from a position nearer the city. They occupy ground considerably diversified in surface, and are in general well drained. The pens and lanes are paved with cobble-stones, and the feeding-yards are furnished with sheds. In many cases these yards are so narrow that the sheds occupy above two-thirds of their width, leaving little more than one-third open.

The mangers were supplied with hay, not so freely as at Chicago, or even at Buffalo, so that less was littered about the yard; but all appeared to get what they required, and were

to be seen lying down and ruminating after being in the yards two or three hours.

The water-troughs are too small, and are inconveniently placed in the corners of the yards, under the fence, so that each serves for two adjoining yards, and, although they look wide enough, each half is too narrow. In many cases they are inconveniently high; indeed, in some cases the earth in front of them, kept wet by leakage or overflow, had been trodden into mud knee-deep and worn away by the feet of the cattle, so that troughs originally too high were altogether out of the reach of ordinary cattle, unless nearly or quite full, as they were in no case found to be. The supply of water being limited, it is usually kept shut off, and only turned on after cattle are put into the yard. The pipes are small, the current slow, the troughs leaky in consequence of standing empty at times; and the consequence is that for a long while the depth is too little, being at the bottom of a deep and narrow trough, the top of which is three and a half or four feet above the ground on which the animals must stand to drink, for them even to touch it with their noses or tongues.

Having satiated themselves with the palatable water at Buffalo, they did not appear to be very thirsty here, and with the patience of their race, turned quietly away after a fruitless attempt to drink; but they must suffer for water before reaching Brighton. Indeed, some drovers are known to resort to the shallow trick of keeping their cattle from drinking at Albany in order that they may drink with the greater avidity at Brighton, and thus diminish their apparent loss of weight, or shrinkage; but this artifice is too transparent to be often successful, and cannot surely be a common practice. A more abundant supply of water is soon to be furnished, I was told, at the Albany yards; but the inconvenient height of the troughs, if not their ineligible location, should be remedied without delay.

The platform at these yards was in very bad condition. About half the planking was quite rotted and worn away, and the ground between the remaining planks was trodden into holes a foot or more in depth, the whole presenting the appearance of a corduroy road exceedingly out of repair. To add to the imminent danger of accidents in loading and dis-

charging, the bridges, originally too narrow for the enlarged car-doors now in use, were badly worn, split and broken, so as to be treacherous and dangerous. A great many cattle fell with their hind legs between the car and platform, in consequence of the bad condition of both platform and bridges, sometimes to their very serious injury, while I was watching the discharge of three trains, on the twenty-third day of September last.

Some facts respecting the business of these yards are printed in a foot-note to page 81.

Stock-Yards at Brighton.—These yards are very far short of the requirements of the business, and in several important respects inferior to many, if not to all the great stock-yards of the West.

A very noticeable defect is the small number of sheds, which our climate renders especially desirable, and which the enfeebled condition of the cattle, after their long journey, in many cases emphatically calls for.

It may be an illusion; but there seemed to me to be some evidence of a feeling prevalent, if unspoken, if even unconscious, that these animals had about reached the end alike of their journey and of their lives, and that any further care for their comfort and health would be superfluous and wasteful. Certainly such a sentiment must be repulsive to a humane mind, and cannot be by any means general among a class of men not deficient in humanity, and possessing a high degree of enterprise and business capacity, such as the men engaged in this trade are for the most part. But that the care which these animals receive diminishes as their fatigue and exhaustion increase, towards the end of the route, is too painfully evident.*

It must be borne in mind, too, that Brighton is by no means the last stage in the journey of a very considerable proportion of the animals received there. Large numbers are shipped by rail to Providence, Pawtucket, Fall River, New Bedford,

* Of the earlier stages, from Texas, Kansas, and Colorado, before reaching Chicago, I can only speak from hearsay, and if all that is said on the subject is true, there is room for very great improvement. Even the wise and humane law of the United States on the subject requires, it is said, vigilant inspection to insure obedience.

and the Cape; and to Lawrence, Lowell, Lynn, Salem, and Newburyport; and even to Portland, Manchester, and Concord, and other towns and cities in New England; and no inconsiderable number are driven on foot a weary distance, without food or rest, as if for the purpose of draining the last drop of vitality out of their exhausted frames.

The railways doing this business of re-distribution are in general poorly provided with cars, yards, platforms, and facilities of all kinds to transact it properly. Common box-cars have too often to serve for cattle-cars, causing extreme suffering from heat in summer, and from deficient ventilation at all seasons.

Cattle are often compelled to wait, standing for hours, for trains to be made up, and are subjected to distressing shocks in the process, by frequent stopping and starting.

The routes are short, it is true, if the time is not; and the degree of hardship and suffering they give rise to might be quite supportable by animals in high health and good condition; but coming at the close of a long, exhausting, and harassing journey, every stage of which, endurable by itself, serves to aggregate and intensify all the ill-effects of the previous stages, these short routes of distribution around Boston are not without importance to the general question of transportation as affecting the health of the animals, and the healthfulness of the food they furnish to this community.

Union Stock Yards; Watertown.—There could be found no more striking illustration of the improvement I have already mentioned introduced in the construction of new stock yards, than is to be found at our own doors in the yards erected two or three years ago by the Fitchburg Railroad Company at Watertown, and used by them conjointly with the Boston & Lowell Railroad Company, which two companies together have brought to our market annually, for the last three years, a mean number of 42,229 head of cattle, or nearly 26 per cent. of the mean annual aggregate, and 21,760 sheep and lambs, or 5.5 per cent. of the mean annual number, for those years. These yards are located on ground very nearly level, and extend about 1,600 feet along the line of road, which is there straight,—the receiving-pens extending to a

still greater distance. The platform, about level with the floor of a car, is sustained by a substantial wall, coped with split granite, and formed of gravel. The yards are equal in length to ordinary stock-cars, about thirty feet, and are about square, thus affording ample space for animals released from cars about eight feet wide. Gates nearly equal in length to the width of the platform, give easy access to these yards directly opposite the car doors, and when open, shut off the portion of the platform abreast of them from other portions. A wide street, parallel to the railway, skirts these yards, and on the opposite side gives frontage to three large buildings, each about eighty feet wide where abutting on the street, and about 220 feet deep; one being used for a stable for cows and other cattle, and the other two for sheep-folds.

Two streets, at right angles with this main street, separate these three buildings, two others skirt them on their outer sides, and eight others, four on each side of these central buildings, extend back the same distance to a street in the rear, and give access to storing and feeding-yards, four on either side of each street save the outer ones, which at present have yards only on one side.

These yards are about fifty-five feet square, and have rows of sheds along the line common to each two tiers of yards, parallel to the cross streets and midway between them. The feeding mangers and watering-troughs are excellent, drainage is provided, and no desirable feature seems to be omitted. There is a large and commodious hay-barn, a convenient scale-house, with Fairbanks' scales; and at suitable distance there is a good-sized hotel, said to be well kept, and doubtless a busy, stirring scene on market-days. The arrangement of the cow-pens and stalls, the provision for sheep and calves, are all as good, apparently, as can be made. Cattle arrive, generally, only once a week, in any quantity, and are seldom kept even a few hours; but sheep and cows are sometimes kept here two weeks or more, and if properly cared for, as it is said they are, must be perfectly comfortable.

A direct comparison of these admirable yards with the yards at Brighton, already described,—which can be made in two hours, as they are but a short distance apart,—will bring into one view all the progress in this direction which has been gained in thirty years.

OUR MEAT SUPPLY, AND PUBLIC HEALTH.

BY CHAS. F. FOLSOM, M. D.

(SECRETARY OF THE BOARD.)



OUR MEAT SUPPLY, AND PUBLIC HEALTH.

In the earliest records of civilization, there is evidence of legislation with regard to the different kinds of food suitable to be eaten by man. These were prescribed minutely, in part, probably, as sanitary regulations, in the laws of Moses, and also in those of Egypt. Hippocrates, the founder of medicine, who flourished at the time of the highest glory of Greece, gave very minute directions with regard to diet, both for health and for disease; and in later times the subject receives more attention in proportion as science advances and communities become more intelligent. In fact, with our present knowledge of food, although we are as yet only on the threshold of inquiry, we can often prescribe it with as much precision as we can use digitalis and opium.

Although physiologists are not agreed that *animal* food is absolutely essential to a high degree of civilization, there are certainly many facts which seem to indicate that it is resolvable into a greater amount of force than the other nitrogenous foods.

It is true that many tribes of North American Indians have attained a very high physical development upon a vegetable diet; that many healthy Scotch farmers live chiefly on oatmeal; that the laboring classes in Europe rarely eat meat; that a large proportion of the inhabitants of Great Britain formerly lived on bread, cheese and beer; that the former slaves in our Southern States received meat only exceptionally; that the Roman legionary soldier carried a weight of sixty pounds, and performed feats of strength and endurance that have astonished the world, without eating flesh; and that a few modern vegetarians have substituted milk and eggs (which, however, contain the elements of animal food) for butcher's meat in their diet, without suffering from it;

while the Brahmins of India eat nothing which breathes or contains the germ of animal life, although they can hardly be said to have attained a vigorous physical or mental culture. Nevertheless, as a rule, when hard-working people have not eaten meat, it has been because they could not get it.

As far back as the time of Homer, the poorer classes in Greece ate blood-sausages, because they could not afford meat; and at Rome, in the time of the empire, it had even become necessary to issue pork in addition to corn to the destitute,—the forests of Lucania furnishing thousands of pigs yearly to the imperial city, while the neighboring plains were dotted with sheep and cattle for the wealthy classes. In recent years it has been found in India that the Hindoo workmen on the railroads could not work steadily till they had meat added to their diet,—their usual food, consisting almost exclusively of rice, having proved insufficient. Dr. Kane, in his "Arctic Explorations," has expressed his belief that the timely arrival of fresh meat had saved the lives of some of his men; and Dr. Livingstone says that in South Africa both the members of his expedition and the natives would "eat anything to get animal food." Liebig ascribes the greater endurance and efficiency of American workmen, as compared with those of Europe, to their meat diet; while Dr. Ray attributes some of the transient illnesses in New England to a too free use of meat.*

In the last edition of his "Principles of Human Physiology," Carpenter says:—

"Whilst, on the one hand, it may freely be conceded to the advocates of vegetarianism that a well-selected vegetable diet is capable of producing (in the greater number of individuals) the highest *physical* development of which they are capable, it may, on the other hand, be affirmed with equal certainty that the substitution of a moderate proportion of animal flesh is in no way injurious; whilst, so far as our evidence at present extends, this seems rather to favor the highest *mental* development."

The experiments of Houghton and others have certainly proved that more food is necessary for hard intellectual labor

* Mental Hygiene, p. 82. The question has been suggested whether some of our superfluous energy or nervousness might not be explained in this way. The average daily consumption of meat in London is about four ounces to each individual; in the places supplied by the Boston markets it is estimated to be not far from twelve ounces.

than for a corresponding amount of physical exertion; and M. Metz testifies to the value of a liberal diet in making his boys in the reformatory school at Mettray more manly.

But whatever physiological theories may prove correct, it is certain that meat contains nitrogenous, fatty and inorganic elements of food in a palatable and easily assimilable form; and the nearly universal experience of mankind has shown that its place cannot be fully supplied by any substitute. It becomes, therefore, a matter of vital importance to every state, that its meat markets should be under the most careful supervision.

Since the time of Moses, the Jews have carefully inspected all meat sold in their markets; although their rules, based, probably, on the best sanitary knowledge of some thirty centuries ago, are not sufficient to keep diseased meat from their tables, and their method of slaughtering is unnecessarily cruel. And now most of the large cities in Europe, as well as some in America, have followed the leadership of Paris in having rigid examinations, both before and after slaughter, of all animals intended for human food.

A wider attention to matters of this nature, and a deeper interest in them, leading to vigorous action, would be justified by their intimate connection with human welfare. In fact food, through its effect on the health, and through the necessary operation of physical laws, determines, in no small degree, individual and national character, and consequently shapes, to some extent, national policy. But, not pausing to dwell on these considerations, the present article will be devoted to a consideration of the conditions under which the quality of meat is injured for human food, and, of course, deals with only a very small branch of the general subject. The various changes in the tissues of animals, both before and after slaughter, will be considered with reference to their influence upon the health of consumers, beginning with the commonest form,—putrescent meat.

PUTRID MEAT.

The testimony is very conflicting with regard to the precise amount of injury arising from the consumption of meat which has become more or less decomposed.

On the one hand, it must be acknowledged that enormous quantities of putrid meat are daily eaten without very immediate or striking ill-results. On the other hand, slight illness, and even dangerous symptoms, have been so often reported as to leave no doubt that the inspectors of nearly the whole civilized world are at least partly right in condemning putrid meat when offered in the markets as human food.

The inhabitants of the Faroe Islands habitually eat their meat in a high state of putrefaction, and enjoy from its fermented condition a sense of stimulation similar to that which the Sandwich Islander gets from his fermented potato; and the plantation negroes of the United States, for want of animal food, have not infrequently been known to eat condemned and even rotten bacon, and, in most cases, without evident injury. In some parts of Russia, and in the polar regions, rancid blubber and offal and meat constitute at times the chief articles of diet; and in modern cities decaying meat is sold and eaten by tons without any marked evil results being noticed, while the "high" condition of game necessary to suit the tastes of many epicures is well known. Dr. T. K. Chambers of London states that "tons and tons of decayed and purulent meat, which, if seen by the inspector would properly be condemned as unfitted to the dignity of the human table, are yet surreptitiously made into sausages in London, and hitherto no case of sickness has been traced to this cause."* Decroix states that putrid meat was eaten to a great extent during the siege of Paris, without producing any serious results; but it must be remembered that illness, unless very severe, would have passed unnoticed at such a time; that disease and death were making frightful ravages in the city; and that, just as during the siege of Rome by Alaric, it is impossible to say to precisely what extent unwholesome food contributed to the sum-total of disease. During the siege of Mantua, a diet of putrescent meat was considered by Foderé to have caused gangrene and scurvy. The epicure who eats putrid meat is especially liable to attacks of gout; the game suiting his palate often gives rise

* But the lower classes in London live under circumstances most of which are positively known to be prejudicial to health; and we must have a more delicate balance if we would weigh all evidence exactly.

to diarrhœa in those not accustomed to its use; and the races that feed habitually on decomposed meat are weak and of slight power to resist disease.

The instances where putrid meat has given rise to serious symptoms in those eating it are numerous, and to be found in all books on legal medicine. Six hundred people who ate ham and veal in a state of incipient decay at Zürich all became ill, and several of them died. Ollivier reports a case where six people ate some putrid mutton and became violently ill, while four died. Christison mentions the facts of fourteen persons having become very ill with diarrhœa and vomiting from eating veal so slightly decomposed that its appearance was perfectly good, and of five individuals having suffered from marked illness by eating broth made of decayed meat. During the cholera epidemic in London, in 1848 and 1849, it was clearly proved that those persons who ate putrid meat suffered especially. Professor Gamgee states that illness and death have been attributed on good authority to eating mutton in a state of incipient decay.* In one of the large American hospitals, five years ago, there were several epidemics of fever, prostration, diarrhœa and vomiting which were traced directly to beef-tea made from somewhat decomposed meat. Only those already quite ill were made very sick, while a person in robust health could take the same food without striking ill-effects. The beef-tea was not in all cases of disagreeable taste or odor.

If it were possible to make as accurate experiments with regard to decayed meat as we can with air and water, we should undoubtedly find that, when eaten, it produces, in the vast majority of cases, a depression of the general health, if not actual sickness. In a mild degree, the symptoms are lassitude, slight headache, dulness, indigestion and loss of appetite. As instances of severer form, Professor Parkes states that "diarrhœa and vomiting, followed by typhoidal symptoms, are not uncommon after eating butchers' meat, so that poisoning is suspected, but no evidence of it found," and that "such instances become more numerous as attention

* In this case, the sheep furnishing the meat was found to have had the "rot" or "liver-fluke."

is more directed to the subject." In Paris, not infrequently, the police are called to investigate cases of suspected poisoning, when the only ascertained cause of trouble has been the eating of decayed meat.

In a recent report of the Committee of the Metropolitan Association of Medical Officers of Health of London, is the following statement:—"Although it may be difficult to prove it by actual cases, there can be no doubt that unwholesome meat is one cause among many of the debility and cachexies, the poverty of blood and intractable maladies of the poor who flock to the dispensaries and parochial medical officers, and especially of diarrhœa during hot weather." Dr. Letheby says:—"I have often had to investigate cases of mysterious disease which had undoubtedly been caused by unsound meat." Dr. Pavy's opinion is that "experience shows that the resisting power enjoyed by those accustomed to our mode of living is not sufficient to allow meat tainted with decomposition to be consumed without incurring a risk of more or less severe gastro-intestinal derangement, if nothing more, being set up."

Perhaps, as Liebig suggests, a bit of old cheese, or a small piece of fermented meat may communicate the fermentative process to the rest of the food in the stomach in such a way as to assist digestion; but we know that a large quantity of putrefied matter induces similar changes in organic matter exposed to it;* and the result, if in the stomach, must be decomposition, liberation of gases and indigestion. "Sometimes some of the putrid substances are absorbed, as there are signs of evident poisoning of the blood, a febrile condition, torpor and heaviness, fœtor of the breath, and sometimes possibly even jaundice."†

Typhoid fever enters our systems in the air we breathe and in the water we drink; and the question has been very

* An intelligent butcher in Washington, D. C., informs me that if he leaves a small piece of putrid meat even in his ice-house over night, the other meat exposed to it becomes mouldy; and Mr. Hammond, President of the Refrigerator Car Company, which sends daily to Boston alone twenty tons of fresh beef in excellent condition, writes:—"My experience is that putrid meat in a close room or a common ice-box would set up decomposition with the balance of meats in the close chamber, if kept confined any length of time."

† Parkes.

plausibly asked, whether eating putrid meat may not be responsible for a certain number of cases.*

In metropolitan hospitals, especially where there is not infrequently tainted meat used (disguised in cooking or not), it is a very noticeable fact that there are days when a large number of patients are not as well as usual, and that, too, without any evident cause; while the great frequency of headache, languor, want of appetite, etc., in ordinary life, which remain unexplained even after giving the frying-pan and the air-tight stove their full share of credit, should make us careful in deciding that putrescent meat may be eaten with entire impunity, even when that is apparently the case.

The antiseptic effect of good cooking, and the great power of the system to select and assimilate what it requires, and to reject what is superfluous or injurious, probably in most cases protect active, vigorous persons from the harmful effects of eating unwholesome meat. But for the weak and the sick, and for all who live under the complicated circumstances of a highly civilized life, demanding of their brains and muscles all the work that can be got out of them, it is manifestly of the greatest importance to have all the conditions of living as perfect as possible, and to admit no source of even possible injury into their systems. Nor should we be deceived by the seeming tolerance of evil influences which our organs manifest by long habit.

If decaying meat is seen before being cooked, its "slippery" appearance, its softness to the touch, and its somewhat pale hue, render its detection easy, while the odor is unfailing in later stages.

If meat is salted, a slight amount of putrefaction is thereby arrested, but not if softening, or discoloration, or odor are markedly present; and in such cases decomposition would probably often pass undetected.

The sausage, however, is the grand receptacle of vile meat of all kinds, where it is spiced into obscurity; but in the majority of cases, even here, thorough cooking may be relied upon to prevent any evident disagreeable results. Still,

* Compare also Dr. Griffith, Medical Officer of Health, in his last report for the borough of Sheffield, England:—"Foul air, polluted water, and unsound liquid or solid food, are the chief sources of fever" (typhus and typhoid).

Bologna sausages are eaten raw; and in the vicinity of Boston fetid and purulent meat is sometimes used in their manufacture; while veal is dressed which the owners would not dare to offer for sale in any market, and is carried to some of the five manufactories in our suburban towns, where also are received the carcasses of animals in which killing has been nearly, if not quite, a work of supererogation.

In this connection it may be proper to allude to the poison, of not entirely certain chemical composition, which is found in sausages, ham and bacon, at a certain stage of decomposition. It may not have caused the fatal results in this country that have been observed from it in Europe, but it would not be surprising if such cases should pass undetected with us, where there is no careful system of medical police. In Würtemberg alone, four hundred people have been made dangerously sick, and one hundred and forty have died, from the effects of this poison during the past half century. It may be that the poisonous properties of brine which has been used over and over again are due to similar chemical changes.

PARASITES.

It is not yet certainly known how many parasites are to be found under various circumstances in man; and of those with which we are tolerably familiar we cannot in every case say precisely how they gain entrance to our systems. Of the ten or more *tæniæ*, or tape-worms, found in the human body, only one is quite common in America, a second is somewhat rare, while the rest belong rather to the curiosities of medical experience.

I. The *tænia solium*, or solitary tape-worm, so called because usually found singly, although two, three, or four, or even ten may co-exist in the same individual, is fully developed only in the intestinal canal of man.

It is chiefly to the researches of Küchenmeister and Siebold that we are indebted for our knowledge of its natural history.

The worm is from five to forty feet long, about one-third of an inch wide at its widest part, with a slender ribbon-like neck. It has a globular head, which presents four circular discs or "suckers" at the sides, and at the top a double row of concentric hooklets, by which the parasite attaches itself to

the mucuous membrane of the intestine of man. The body consists of numerous rectangular articulations or proglottids, which are developed from the neck by a sort of budding process, thereby pushing down the remainder of the body and increasing the length of the parasite. It will thus be seen that the head, with a small part of the neck, is sufficient to keep up life and procreative power, even if the rest be destroyed. Each one of these articulations contains all the organs necessary for reproduction, and may discharge nearly fifty thousand *ova*, or eggs. The ova and the proglottids containing them are discharged almost daily with the excreta of infected men.

The *tæniæ* are probably long-lived. Flint thinks that under favorable circumstances they may live a dozen years or more.

The symptoms of their presence are obscure, being chiefly those of irritation and insufficient nutrition, or reflex and involving the nervous system; and the tape-worm lives on those elements of food which are most easily assimilated. The disease is an unpleasant one, but is not in itself dangerous, except as it may be a source of infection for the *cysticercus* or larval form of the worm; and the cure in uncomplicated cases is generally not difficult if properly conducted.

The *tænia solium* is not as common in this country as in Ireland and North Germany. Still, it is probably much more common than is generally supposed, as Dr. Hand's investigations have shown in regard to Minnesota.

As far as at present known, the only source of infection for man is the flesh of swine containing the *cysticercus cellulosæ*, which is the larval form of the *tænia solium*. Future investigations, however, may prove that the *cysticercus* found in deer, apes, bears, dogs, rats and wild boars, is one and the same with that of pigs.

According to Pappenheim, the ova of the *tæniæ* are not susceptible of development into *cysticerci* unless they be for a time exposed to the air, so that the ova existing at any time in the intestinal canal of any individual man must be first discharged with the excreta and then re-ingested through the medium of contaminated drinking-water, etc., before they can assume the larval form. Heller, on the contrary, states that they may be forced from the intestine to the stomach in

vomiting, pass back again from the stomach to the intestinal canal, and thus meet conditions favorable to development into cysticerci, so that both forms of the parasite may exist in the same individual, and the ova discharged from one man may prove a source of infection for another.*

When cysticerci cellulosaë are found in man, their migration from the intestinal canal to the various parts of the body probably takes place in two ways.* They either pierce their way directly through the soft parts, following, perhaps, the course of the lymphatics, or they get into the circulation, possibly through the medium of the portal vein, and are carried along in the current of the blood. During this stage there is some illness and pain. Dangerous or fatal symptoms appear when the parasites are lodged in some sensitive or vital part, as the eye, heart, spinal-cord, or brain. As many as three thousand have been found in one individual, and Griesinger states that in the brain they occasionally give rise to insanity.

The infection with the cysticercus cellulosaë (the form of the parasite found in swine), in the case of man, is a disease of middle age, and commonly of the lower or uncleanly classes of Europe. In this country, it is either extremely rare or it has passed undetected.

The cysticercus forms for itself a cyst or bladder, filled with clear, serous fluid, from one-eighth to one-half an inch long, according to its age, the whole process of development requiring two or three months. This cyst becomes surrounded with a capsule of cellular tissue, except in the brain, where it is often wanting. In this form, if undisturbed, the parasite lives from three to six years, dies, undergoes fatty degeneration, and the soft parts are absorbed, leaving a hard, chalky concretion in which the characteristic hooklets of the larva can be found with the microscope (Stich). This is the most favorable result to be expected, as no therapeutic measures are of any avail unless the cysts are superficial enough to be removed with the surgeon's knife.

The segments of the tapeworm discharged with human excreta are greedily eaten by hogs, and in a few days a certain proportion of the ova (according to Leuckart, about one in 1,340) become developed into cysticerci cellulosaë. Dr.

* Ziemssen's Handbuch, 1874.

Thudicum states that this development occurs only in young pigs less than a year old, and that it is an error to suppose that the fœtus can be infected. While the parasites are migrating from the intestinal canal to the voluntary muscles, chiefly of the fore part of the body, pain and symptoms of inflammation are present in the pigs. They are found so nearly universally under the eyelids and tongue, that the French and German inspectors at sea-ports and depots of transportation, examine all hogs in these two places, as a crucial test for the presence of the cysticercus. The test, however, is not necessarily infallible. The cyst of the larva lies usually in the connective tissue, between the muscular fibres, is oval, translucent, and as large as a pea or bean. Its duration of life, as in man, is from three to six years.

These small "bladders," scattered through the muscles, give rise to an appearance which gives to the meat the popular name of "measly" pork, which was first mentioned by Aristophanes, and was known to Aristotle.

The symptoms, if the disease is severe, are those of fever and gastro-intestinal pain and inflammation, while the animal is alive. The shoulders become broad, the loins narrow; there is always inflammation of the inner surfaces of the eyelids, and often hoarseness, difficulty of breathing and lameness. In "measly" meat, the small cysts, partially filled with fluid, are readily recognized with the naked eye, unless their number be quite small, or they be shrivelled by drying. When taken into the human stomach, they are digested, setting free the larvæ, which, in a certain proportion of cases, if still alive, become tapeworms in about two days.

The destruction of the parasite cannot be accomplished by rupturing the sac, and allowing the fluid to escape; but it is killed by *thorough cooking*, at a temperature of 192° F. (Flint), and by *salting*, dry or in brine, in such a way that each cysticercus be thoroughly exposed to the action of the salt. It must be borne in mind, however, that thin-walled cysticerci, on the surface, may be destroyed, while tougher ones, imbedded among the powerful muscles, and at the centre of a piece of pork, retain their vitality, and that lard may contain them in a living state even after having been

melted.* In fresh meat the parasite has been known to retain life for two or three weeks, but it may very possibly live much longer. The English soldiers, in the Crimea, are said to have been infected from meat which had been imperfectly salted in Ireland and transported to the seat of war.

II. The *tænia mediocanellata*, the tape-worm of the ancients, is also found only in man. It resembles the *tænia solium* so much in appearance, that it was mistaken for that parasite until Küchenmeister, in 1852, showed that it has larger sucking discs, is fatter in appearance, and has more branches of the uterine organs, beside having no "hooklets" on the head. Its larvæ form, the *cysticercus tæniæ mediocanellatæ*, is found only in beef and veal, it having never yet been observed in man. The ova discharged with human excreta are accidentally snatched up, in small numbers, by cattle, with a mouthful of grass, or are ingested with contaminated water, instead of being devoured in great numbers, as in the case of hogs. For this reason, it is very rare for many cysticerci to be found in neat-cattle.

The cysts contain larvæ which are about one-fourteenth of an inch in length, resemble the "measles" in pork in appearance, natural history, development, symptoms, etc., and, so far as is now known, meet the requisite conditions for attaining maturity only in young cattle.

It is not positively known how long these parasites may live; but in one case they were found by Cobbold to be dead eleven months after the time of infection, which renders probable the statement of Dr. Thudicum, that they are not likely to be found alive in beef from cattle over three or four years old. They seldom exist in such numbers as to give rise to marked symptoms during life.

In beef they are detected with great difficulty, from their small size and small number. They are effectually destroyed by the same measures as are used in the case of "pork measles."

The *tænia mediocanellata* is very common among the Abyssinians, who eat great quantities of raw beef. It is the common tape-worm of Middle and Southern Europe, and has lately been found so frequently in England as to be called the

* In Paris all infected lard is rendered unpalatable by pouring oil of turpentine upon it at the time of inspection.

tape-worm of the upper classes. It is more or less prevalent in most parts of the world. Before Dr. Leidy reported a case of the disease from eating raw-beef sausages, in Philadelphia, and possibly since then, many cases in America must have been mistaken for the tape-worm derived from swine. Leuckart, Weisse, Trousseau and others, have reported cases of the disease from giving raw beef to young children suffering from exhaustive diarrhoea.

As with the *tænia solium*, the cure is not usually difficult.

Whether the *cysticercus ovis*, found twice in mutton by Cobbold, belongs to still another variety or not,—whether it is only accidentally developed in sheep, and whether man may be infected from it,—are questions not yet decided.

III. The *bothriocephalus latus*, formerly called *tænia lata*, concerns us at present, only as it is occasionally imported with immigrants. It prevails chiefly in the extreme north of Europe, to a certain extent also along the banks of some of the rivers of the Old World, but not in the United States. It is about an inch wide at its widest part, has no bulbous head or sucking discs, and differs somewhat from the *tænia* proper in its reproductive organs, although it is bi-sexual. Its larval form may, in the future, be proved to be transported to man through the medium of cattle; but there are some reasons for supposing that it exists in fishes, especially in salmon of particular localities, although nothing positive is known of it.

IV. The *cysticercus tenuicollis*, the most common parasite of ruminants, is found in the abdominal cavities of a very large proportion of the sheep slaughtered in the United States. Of a large number of sheep examined by Dr. Thudicum, in London, ten years ago, nearly every one had more or less of the characteristic "water-bladders." It is found occasionally in other ruminants, squirrels, monkeys and pigs; but there are no authentic reports of its ever having been found in man. It is developed fully in the abdominal cavities only; but the lungs of sheep are often studded with those which have died there, not having met the conditions adapted to sustaining life.

In the early stages of this disease, it would be difficult to prove that mutton is in any way injured as food by it; but, in the later stages, which are accompanied by cough and

wasting and poverty of blood, the flesh of the animal certainly loses in nutritive value, although it has not been actually proved to be injurious as food.

Sheep become infected by accidentally ingesting with their food or drink the ova of the *tænia marginata*, a tape-worm not uncommon in dogs.

V. Only a few instances of *cysticercus acanthotrias* have been reported in man; nor is it known from the ova of what tape-worm he must defend himself to escape the parasite. It may or may not be derived from animals that are eaten.

VI. The *cysticercus tæniæ echinococci* is the most dangerous of the parasitic diseases of man. According to Cobbold, it is found also in the monkey, ox, cow, sheep, horse, ass, goat, camel, deer, chamois, pig, zebra, kangaroo, giraffe, squirrel, and in several of the feline animals. Siebold states that turkeys suffer from them also.

The disease in man prevails somewhat in most countries, but is rare in America, owing to the comparatively slight extent to which dogs are used here in the care of sheep. In Iceland, where there are six dogs and eleven horned cattle to every peasant, all living in rather intimate relations with one another, it causes one-seventh of all the deaths. Hjaltelin, of Reykjavik, places the mortality from this cause even at one-fifth of the total.

To complete its cycle of life, it infects three animals in succession. The corresponding tape-worm is found only in the intestines of dogs and wolves; in Iceland, in nearly every dog. Dogs eat the offal (liver, lungs, spleen, etc., etc.) of sheep infected with the larval form of the disease; the sac is digested in their stomachs, setting free the embryos, to be developed in their intestinal canals into tæniæ; and the ova of these tape-worms, discharged with the excreta of the dogs, find their way, presumably through the medium of contaminated water, edible plants, etc., into the intestinal canal of man, to be developed in turn into the larval form, consisting of a series of cysts, one within another, sometimes found singly, sometimes by thousands, and constituting the so-called hydatids of the liver, lungs, brain, etc. Davaine quotes cases of their having been found in the spinal cord, eye and bones.

They multiply by endogenesis, and the parent cyst sometimes attains the size of a man's head (Trousseau).

They have been described more or less understandingly from the time of Hippocrates. According to Dr. Beale, the *cysticercus* itself and singly is one two-hundredth, and the corresponding tape-worm one-fourth of an inch long.

The symptoms in man are, as a rule, in direct proportion to the vitality of the organ invaded. The cysts sometimes undergo spontaneous absorption, or may be occasionally removed with the surgeon's knife.

The flesh of sheep, suffering from this disease, deteriorates in value; but the facts at present known do not admit of our saying whether it is actually injurious or not.

VII. The *cœnurus cerebralis* is another of the "bladder-worms," and is commonly found in the brains of sheep; rarely, also, in the livers of rabbits. It produces in sheep a disease popularly called "gid," which is attended with marked cerebral symptoms, and is not infrequently fatal. Where the disease is so slight as to be discovered by accident, the flesh of the animal could hardly suffer. Where sheep are killed to avoid their dying of the disease, the mutton must be at least poorer in quality; perhaps not absolutely injurious in all cases. The corresponding tape-worm is found only in the intestines of dogs.

VIII. The *cysticercus pisiformis*, found in hares and rabbits, is the larval form of a parasite, which is found fully and sexually developed in dogs, cats and foxes. The flesh of the infected animals becomes pale and anæmic in course of time, and is rendered less nutritious as food. The parasite does not infect man.

IX. The *distoma hepaticum*, or liver-fluke, sometimes called "flounder," from its resemblance in shape to the fish of that name, belongs to a different order from the parasites already mentioned. It is about one inch long, one-half an inch broad, is the pest of animals grazing on wet lands, and produces the disease commonly called "rot," which destroys so many sheep in all parts of the world; in England alone sometimes a million in one year. The distomata introduced with the food or drink of sheep, creep to the narrowest part of the gall-duct, where they remain, setting up inflammation

and catarrh, and causing more or less local inflammation of the liver, obstruction of the vessels, re-absorption of bile, and, finally, anæmia, jaundice, dropsy, etc.

The flesh of such animals loses decidedly in nutritive value, and many assertions have been made that it is positively injurious as food. The latter fact has not yet been proved to be true, although it would be hard to conceive of it as otherwise; and such meat is known to putrefy early. The livers themselves cannot fail to prove bad food.

Like the *tæniæ*, the distomata are hermaphrodite. The ova discharged with the excreta of sheep are probably capable of development only in stagnant water. After bursting the egg-shell, the embryo swims about with its cilia. Probably it then passes into small molluscs, which are accidentally taken up by sheep (or perhaps also occasionally by man) with their food; but the larval form has not yet been distinctly recognized. The distomata occur very exceptionally in the livers of men, and the source of infection is not yet positively known.

X. The *distoma lanceolatum*, about one-eighth as large as the last-described worm, has a similar natural history, and produces similar, but less marked, symptoms. It is also much more rare. Its locality is in the gall-ducts of sheep and horned cattle, and has been observed three times in man.

XI. The *strongylus filaria* belongs to the same order as the *trichina spiralis*. It exists in great numbers in the lungs of sheep in Europe, where it gives rise to local inflammations, cough and emaciation. The female worms are from one to three inches long, the males about one-third as large. The ova and embryos are coughed up by infected sheep, and are readily swallowed with their food by others, finding their way into the air-passages, probably during the process of rumination.

It is not yet certainly known whether the ova must be exposed to any conditions found only in the external atmosphere in order to be developed into full-grown worms, or whether the necessary conditions all exist in the lungs of the sheep. Several observers have described this disease as found in America; and it was probably imported from Europe, as it is not common enough here to lead us to suppose that it

is indigenous. As the parasite is not infectious to man, the subject interests us here only as the meat of infected animals is of inferior value as food, and may possibly be injurious.

XII. The *trichina spiralis*, is, next to the echinococcus, the most dangerous parasite infecting man. It is found also in pigs, foxes, guinea-pigs, rats, cats, mice, marmots, pole-cats, martens, badgers, hedge-hogs, raccoons, moles and dogs, but only as the greatest rarities. Pigs are supposed to become infected chiefly from eating rats, the offal of other pigs, and the excreta of men containing young trichinæ.

It is doubtful whether a single case ever occurred where man became infected otherwise than by eating *raw or under-done* pork, and the most common sources of infection are sausages, ham and bacon.

If the trichinæ existing in pork are very young, they are simply digested when reaching the human stomach, without being developed, and cause simple diarrhœa.

At a suitable age the cyst containing the trichina is alone digested, setting the embryo free. Arrived in the intestine, they become sexually mature, their thread-like appearance rendering them quite recognizable with the naked eye. Countless eggs are discharged by the female, and in about a week's time the newly-hatched worms are making their way to the muscles, either by piercing the soft tissues, or by being carried along in the current of the blood in the vessels, or possibly in both ways, and reaching their full size as larvæ in about two weeks. The male and the female larvæ are both about one-thirtieth of an inch long and one seven-hundredth broad. In some cases severe gastro-intestinal inflammation is set up, and the trichinæ are violently expelled by diarrhœa without getting into the muscles at all. If it were possible to diagnose the disease with certainty in this stage, nature suggests the appropriate treatment. During the migration of the young trichinæ from the intestinal canal, which occupies for each worm about four days, so that even the most distant muscles may all be invaded in that time, there is great soreness of the body, with considerable swelling of the face and limbs. The pain, fever and constitutional disturbance of this stage may cause death, as may peritonitis, or inflammation of the respiratory muscles or of the heart.

After piercing the fibrous sheath of the muscular fibrils, the embryonic trichinæ become encysted within capsules (one in each) of connective tissue, in which they have some freedom of motion. These capsules, which are from one-fiftieth to one-hundreth of an inch long, are, of course, confined to one spot; and, in process of time, they become calcified,—in man in about two years. At this stage of the disease there is usually some, and not infrequently complete, loss of power in some of the affected muscles, and not a few patients die of exhaustion, while a certain number of them completely recover,—at least as far as symptoms are concerned. The mature worms—the females being one-eighth and the males one-eighteenth of an inch long—do not reach the soft tissues of the body. They live from five to eight weeks, and are discharged from time to time with the excreta, either before or after their death.

Trichinæ, as well as cysticerci, were first discovered in men in the dissecting-room; and they were repeatedly observed, without their import being ascertained, until 1860, when Zenker, of Dresden, explained their origin and relation to certain symptoms, and described the disease trichinosis. Previous to his time, the trichina had been identified only once in pork; although, as occurring in man, it had been well known for a quarter of a century. Dr. Thudicum has estimated that in one case twenty-eight million trichinæ existed in one man.

It is not known how long they may live in the encysted form in human muscles. Langenbeck, of Berlin, has reported a case, where, in removing a tumor of the neck, eighteen years after an attack of trichinosis (which passed for poisoning at the time), he found living trichinæ in the muscles; and they have been known to retain life for still longer periods.

Before Zenker's discovery, very many cases passed for poisoning, typhoid fever and other diseases.* One epidemic, involving over three hundred persons, in Blankenburg, was

* Dr. Germer, health officer of Erie, Pa., to whom I am indebted for many facts in regard to this disease, states that a Hungarian physician told him, eighteen years ago, in Vienna, that eating a certain kind of pork often produced a peculiar form of rheumatism in Hungary.

treated as gastro-rheumatic fever; and it was several years later that the true character of the disease was ascertained with the microscope, by examination of the pectoral muscles of one of the men affected.

Severe epidemics have occurred in New York, Mississippi and Iowa, and isolated cases are constantly appearing in different parts of the United States,—some in Massachusetts having been referred to in previous reports of this Board. About eighty individuals are now suffering from trichinosis in Berlin, nearly as many near Hanover, and a large number in the State of Indiana. At Buffalo, last spring, there was quite a severe epidemic in a pork-packer's family; and a very large number of cases occurred not long ago in one of our Western hotels. The disease is rare in France.

The microscope has several times established the diagnosis in man, through examinations of the pectoral muscles; but this test is not final, if negative. Medical treatment is very unsatisfactory, and can only relieve symptoms.

In pork, the trichinæ may be found encysted or not. They often are in very great numbers,—Dr. Dalton, in one case, having estimated that there were eighty-five thousand to the cubic inch; in another case there were enough in one-half a pound of pork to produce thirty million young trichinæ. It is not known how long they may live, but they have been known to be capable of propagation after remaining one hundred days in putrid pork. The frequency of the disease in swine is probably as great in America as elsewhere, if not greater; but man is not so often infected with us, as less raw or underdone sausage, ham, bacon, etc., is eaten than in Europe.

Of 1,394 hogs, taken at random, and examined by the Chicago Academy of Sciences, twenty-eight were found infected with trichinæ.*

They become more rare as pigs are raised under more intelligent supervision on stock-farms, and are kept from roam-

* This enormous proportion of diseased hogs can be accounted for only on the supposition that there was a severe epidemic at that time.

Dr. Uhde has collected statistics of all the hogs examined with the microscope between April, 1871, and April, 1873, in Brunswick and twenty-four other districts (Amtsbezirken) in Germany. The total number examined was 186,312. Of these, 26 were found with trichinæ and 23 with cysticerci.

ing at large about yards, slaughter-houses, out-houses, drains, sewers,* etc. In the corn-fields of our Western States, and on our best stock-farms, they are exceedingly rare. A large amount of uncooked American bacon is eaten in the manufacturing districts of England, and the "spare-ribs," with the pectoral muscles (one of the most frequently-involved regions), are sold to the poorer classes in the vicinity of our enormous pork-packing establishments; while the muscles of the cheek are made into sausages and sold in our markets; and yet in none of these places is trichinosis especially common.†

On the other hand, in Germany twelve trichinous specimens were found in six hundred and twenty-two examinations of American bacon in Rostock; eight in two hundred and ten in Gothenburg; and twenty per cent. of that examined in Elbing contained trichinæ. Forty persons in Bremen became quite ill with the disease in 1873, from having eaten American bacon.‡

The symptoms of trichinosis in pigs are similar to those in man. Sometimes the presence of the parasite is suspected or verified before slaughter, but very rarely. Trichinæ may be suspected in pork if the muscles, especially those of the fore part of the body, are swollen and dark from inflammation. If the larvæ are encysted, and especially if the cysts have become calcified, they may be occasionally seen (in the latter case as small white or yellowish spots) with the naked eye, or be felt upon section with a sharp knife. When not encysted, and in a large proportion of other cases, they can be detected only by means of the microscope. The impossibility

* A butcher in Erie, Pa., however, recently dressed a hog which he had himself raised with great care. The flesh, made into sausages, became the source of severe illness to several people, and was found to contain trichinæ.

† These two facts may probably be fully explained in this way: The English laborers eat such raw bacon only after it has been hung up for a long time to "season," so that the trichinæ are likely to have died long before they reach the human stomach; and, as to the second case, "spare-ribs" are so thin, that any chance trichinæ would be generally destroyed by even moderate heat, applied for a short time.

‡ Heller, in Ziemssen's Handbuch. John M. Wilson, U. S. Consul at Bremen, writes (December, 1874): "The inspection of hogs is very thorough here, the microscope being always used, and the examination is made by experts appointed by the city government for that purpose. American bacon is not inspected on importation while in the possession of the importer or wholesale dealer; it is, however, subject to the same inspection as other products of the hog when it is retailed by the small dealers from the grocery-stores or meat-shops."

of detecting the disease with the naked eye, in most cases, is especially noticeable from the fact that butchers so often suffer from it.

The trichinæ are destroyed by *thorough drying*, by *hot smoking* for twenty-four hours, by *salting* in such a way that each cyst shall be freely exposed to the action of the salt, and by *sufficient cooking*. According to Gerlach, a temperature above 133° F. kills the worms. Dr. Thudicum puts it at 158° F., but advises thirty degrees higher as a matter of security. Fiedler killed them by exposure for ten minutes to a temperature of 167° F. Pappenheim states that it is safe to eat trichinous pork that has been cooked enough to have lost the blood-color throughout, a change which takes place at 149° F., from decomposition of the blood corpuscles.

Beside those already mentioned, there are many other parasites to which man is liable; but, as they do not gain entrance to his system from the meat which he eats, and do not affect the quality of his food, they will not be here considered.

PRECAUTIONS.

The precautions to be observed, in order to avoid infection from any of the above-mentioned diseases, are, generally speaking, simple, and are threefold:—

- 1st. Prevention of parasitic diseases in animals.
- 2d. Exclusion of diseased meat, as far as is practicable, from our markets.
- 3d. Proper care to avoid eating meat which may by any possibility contain living cysticerci or trichinæ.

Pork.—As regards pork, the only meat from which man is infected with a dangerous parasitic disease, the first precaution is not easy of accomplishment, considering the readiness with which these animals devour all kinds of filth. The greatest care, however, should be used to keep them from getting access to any sources of infection. Of these sources, human excreta, the offal from slaughtered swine, and the flesh of rats, are most dangerous, and, with scarce an exception, the only ones.

Breeding pigs on stock-farms, under intelligent super-

vision, and especially keeping them away from slaughter-houses, out-houses, drains and sewers, are the most efficient means to be relied upon.

To keep "*measly pork*" out of our markets, is not difficult, with a proper system of inspection. By such a course, it has been virtually banished from the London markets, where it was sold in great quantities twenty years ago. *Trichinous pork* can ordinarily be detected only with the microscope, and Heller advises that this manner of inspection should be rigorously enforced wherever pork is sold. This has been done with good results in Brunswick for the past dozen years; and in Sweden and other places for a shorter length of time, with more or less success. Pappenheim, however, thinks (wisely, at least, in respect to this country) that such a system is impracticable, and that the only security lies in diffusing information among the people.* All pork which has been found to contain cysticerci or trichinæ, should be seized, condemned and destroyed by fire, or thoroughly treated with sulphuric acid. Simply burying such meat is obviously not sufficient; and the question whether owners should not be compensated for all property destroyed, is well worthy of consideration, with a view to preventing concealment and fraudulent sales. In every system of inspection, however, some dangerous meat, from one cause or another, will necessarily escape observation, so that the only safe rule to follow is *never to eat any pork which has not been thoroughly cooked*. It is not safe to trust to pickling and smoking, even though combined, as is ordinarily done; and it must be borne in mind that meat is seldom thoroughly cooked when cut in slices more than an inch thick. The fact that two dangerous and often fatal diseases,† which are also seldom to be reached by remedial measures, are not infrequent from eating imperfectly-cooked pork, should, for that meat, render the observation of this last precaution universal, especially as it is so easy of accomplishment.

When tapeworms are known to be present in any individual,

* Dr. Germer, health officer of Erie, Pa., instructs the pupils in the higher classes of the public schools in the natural history and microscopic appearances of the worm.

† In four hundred and eighty cases of trichinosis reported by Dr. Bradley, of Detroit, eighty-two proved fatal.

treatment should be entered upon at once, and all expelled portions of the worms should be immediately destroyed with boiling-water or fire, as there is otherwise danger of self-infection, or the infection of others, with the dangerous parasite *cysticercus cellulosæ*.

Beef.—With regard to beef, it may be said that it never gives rise to a dangerous parasitic disease in man, except in the cases of very young or of debilitated persons, and that, in any case, disease from this source is comparatively rare in this country.

The echinococcus prevails to a great extent only in those countries where dogs and cattle live in more intimate relations with man than is common in the United States. It could be readily extirpated, as Hjaltelin suggests, by shutting up dogs, and treating them medically, at proper intervals. In Iceland, at least, this should be done; and as a matter of security, in all countries, all "water-bladders" or cysts found in slaughtered animals should not only be cut out and thrown away, but they should also be destroyed by fire, instead of being allowed to drop to the floor or ground to be eaten by dogs.

LESS HARMFUL PARASITES.

The rest of the parasites which have been mentioned, interest us only as they may cause disease enough in animals to render their flesh deficient in nutritive value, or absolutely unwholesome. The appearance of such meat usually indicates nothing. It should be inspected at the slaughter-house, and sold at a diminished rate; or, in case of advanced disease, condemned. It would be difficult to find well-authenticated records of serious illness resulting from the consumption of such food, although it is not improbable that such cases may have occurred.

PARASITES AFFECTING SHEEP.

The prevention of the various parasitic diseases in sheep is a matter of vast importance, and is chiefly interesting to the agriculturist. Lambs are especially subject to them, and should be kept carefully from all infected pastures, and also

from those where the grass is so short that they must pull up dirt and parasites with their food. The question of treating, medically, all dogs used on sheep-farms, is worth considering. Inasmuch as it is now more than a century ago that Elkington's discovery of deep drainage showed in what way thousands of sheep might be saved from dying of the "rot," it is rather strange that the information thus gained has not been more generally applied. It is obvious that lettuce, watercresses, and all edible plants gathered in sheep-pastures, where the "rot" prevails, should be looked upon by man with some suspicion.

CHRONIC DISEASES OF ANIMALS.

Of the chronic diseases to which animals are subject, little is to be said. They are chiefly pulmonary consumption, the various conditions giving rise to dropsy, and the Texas cattle-fever. The latter is not at present certainly known to injuriously affect flesh for food, although in New York, six years ago, it was thought by the Board of Health to have caused diarrhoea. A very large proportion of Texan cattle were at one time somewhat affected by it, and large quantities of their flesh have been sold and eaten in our different cities with at least apparent immunity from evil results. In general, the flesh of animals, affected with chronic diseases, is inferior in flavor and nutritious qualities, putrefies early, and in that condition often causes diarrhoea and vomiting, if eaten. Only inspection at the time of slaughter is adequate to recognizing these diseases, although the muscular fibrils under the microscope appear indistinct and sometimes degenerated. In very advanced stages, such meat should be condemned as unfit for human food.

ACUTE DISEASES OF ANIMALS.

Of the simple acute inflammatory diseases, such as bronchitis, etc., which produce only very slight constitutional disturbance, still less can be said, inasmuch as they are very common, and the flesh of animals suffering from them is sold with the best in our markets. More accurate data than we now possess are needed before any positive statement can be made as to their absolute innocuousness in all cases.

Pleuro-pneumonia, now so prevalent in Switzerland, from its insidious and highly contagious character, with its long period of incubation (from thirty to forty days), probably destroys more cattle than any other known disease. During the many more or less wide-spread epidemics in this country* and in Europe, the evidence is cumulative that thousands of sick animals have been butchered and sold in many of the markets of the world, and without any serious disease being traced definitely to that cause; although there have been many individual cases out of the thousands where the flesh of such animals has been suspected of having given rise to sickness. Dr. Livingstone, however, asserts that he has seen in Africa, both among Europeans and natives, very serious illness caused by eating the flesh of cattle that had been so slightly sick with pleuro-pneumonia that the disease was hardly noticeable, and the flesh was apparently sound.† In these cases the virus was not destroyed by thorough cooking.

Since the introduction of the disease into Great Britain, in 1842, the mortality from carbuncle has increased in England from 1 to 5.8, and that from phlegmon from 2.5 to 8.1 in 10,000 deaths. A similar fact has been noticed with regard to Scotland; and in both cases the increased mortality has been ascribed to the fact that so much of the diseased meat had been eaten.

Prof. Gamgee states that in a convict establishment, where such animal food was eaten, there occurred forty or fifty carbuncles a month among 1,520 prisoners.

The attempt to inoculate calves with pleuro-pneumonia, so as to substitute a mild disease for a fatal one, has met with some success, especially in the hands of a few wealthy stock-owners in England, who have found themselves repaid for their great outlay of time and money.

The *hoof and mouth* disease, or *epizootic aphtha*, is ordinarily quite mild, and, if uncomplicated, of short duration (about two weeks), and likely to end in recovery without

* The promptness with which this disease was stamped out by the efficient measures adopted by the legislature in Massachusetts should be an example to all countries.

† May not these symptoms have been in part at least attributable to rapid putrefactive changes in the meat after death?

any other special treatment than attention to cleanliness, food, fresh air, etc.

The external signs of the disease are quite marked. When it prevailed in Paris, from 1834 to 1839, it was not thought necessary to exclude the meat from the markets, and we have the high authority of Levy that no apparent ill results followed. Such meat is not now condemned in *all* the cities of Europe where inspection is thorough, provided the disease is uncomplicated with others, and not severe. Dr. Thorne states that animals suffering from hoof and mouth disease, during the late epidemic, were constantly killed and sold in England, often as first-class meat. In no case had he heard of disease in men attributed to it, and Mr. Simon corroborates his testimony. Since the introduction of the disease into America, in 1870, by a cow imported from Holland, our experience has been similar.

On the other hand, Prof. Gamgee knew a pack of hounds to become very ill from eating the raw flesh of a cow that had been killed while suffering from epizootic aphtha, and in some cities of Europe both milk and meat of the diseased animals are condemned.

The *Rinderpest* of the Germans, *typhus contagieux* of the French, or cattle-plague, now creating such havoc among cattle in the Crimea, is a disease often attended with severe constitutional symptoms, is easily recognized before death, and is very fatal. The dressed meat does not differ in appearance from that of healthy animals. Parent Duchatelet states that enormous quantities of beef so diseased have been eaten in France without any ill results having been noticed from it, and we have the same kind of testimony with regard to the great epidemic in Great Britain, in 1865. Pappenheim also asserts that experience has not thus far shown that there is danger from eating meat diseased by the rinderpest; and Prof. Brücke, of Vienna, even says that the Bohemian peasants dug up, cooked and ate such meat after it had been condemned and buried by the inspectors, and that no known cases of illness resulted therefrom.

Some isolated cases, however, have been reported in

Europe, where even death was thought to have been the result of eating it.

The facts remain, too, that beef so diseased was declared unwholesome by the Belgian Academy, that it is still seized and condemned in many, if not most, of the large continental cities of Europe, and that Dr. Letheby, for twenty years Health Officer of London, in reviewing the epidemic of 1865, states that "it would be very dangerous to permit the unrestricted sale of such meat in all stages of the disease."*

The cattle-plague (also called steppe-murraïn, from the steppes or plains in Russia, where it originates) is énzootic, and, with the rigid care exercised by Russia, Austria and Prussia, will be, in all probability, confined to its source,—the broad plains of Western Asia,—or at least be kept from becoming again a general epidemic, unless quarantine laws be neglected or rendered inoperative in another European war.

In this country, according to the best authorities, the disease has never yet appeared; and those cases which have been from time to time reported as such were, in all probability, something else. It might, without much doubt, be transported across the ocean through the medium of diseased cattle or their hides.

Anthrax, sometimes accompanied by a condition of the leg, which gives it the name of *malignant erysipelas*, rather prevalent, in 1873, in a part of New England,† but generally rare in this country, probably renders the flesh of animals affected with it more dangerous as food than any other known disease, with the exception, possibly, of small-pox in sheep. And yet, in the early stages, the diseased meat is often eaten with apparent impunity, giving rise simply to slight diarrhoea, and in a certain number of cases to no evident unpleasant results whatever.

Menschel reports several cases of persons being affected with carbuncle from this cause. Simon knew of a family of eleven persons, of whom nine ate meat from a bullock which had been killed in not a late stage of the disease. The flesh

* Report on the Sanitary Condition of London, 1865, p. 50.

† Report on the Diseases of Domestic Animals, in Connecticut, by Noah Cressy, M.D.

was eaten on the same day as slaughtered, and looked perfectly good after a few dark spots had been cut out. Of these nine persons, all became quite ill, and two died.

Prof. Gamgee states, in the "Edinburgh Veterinary Review," that he has known diseased cattle slaughtered, the beef of which had the appearance of being the best a butcher can show; and yet dogs, pigs and ferrets have died from eating it, and horses died from drinking the water into which the blood of these animals had run.

In regard to *splenic apoplexy*, possibly only another form of the disease, the same author says, in his report to the medical officer of the Privy Council in London: "Many of the worst forms of disease are very sudden, and only slightly affect the color and texture of the muscular apparatus. A fine, fat bullock, with florid meat, may have died from splenic apoplexy, or been merely killed *pro forma*, when already on the point of death. Remove the spleen, and the carcass appears sound. Yet dogs and pigs in this country die from eating, although first cooked, any portion of such cattle." Prof. Cressy, of the Agricultural College at Amherst, calls attention to the danger arising from the consumption of such meat, and to the large number of evil consequences known to be directly attributable to it. In fact, one would suppose that it can hardly be otherwise of a disease so malignant and so rapidly fatal. Moreover, not less than sixty persons have recently been reported as having become seriously ill from eating beef diseased by anthrax, which, as is usually the case, looked perfectly sound and healthy, so that its condition could have been ascertained only from information got by inspecting the internal organs of the animal. In a certain proportion of cases there are carbuncles on various parts of the body, or a leg may be swollen and discolored. Usually, however, the chief, if not the only, indication of disease is in the spleen.

Charbon, or *black leg*, so called from the almost gangrenous appearance of one of the hind legs, is so dangerous a form of splenic disease, that Prof. Cressy advises the destruction even of the hides of all animals affected with it.

"*Braxy*," which causes such great mortality among sheep in Scotland, is probably anthrax in a modified form. The flesh is eaten very largely, and in the vast majority of cases

without striking ill results, by the poorer classes of the Scotch, but only after having been salted and kept for a long time. Scotch physicians say that even then such a practice is dangerous. Pappenheim, who states that there is no danger from eating the flesh of animals suffering from the cattle-plague, advocates the seizure at the slaughter-houses and the burial of all the parts of animals that have had anthrax.

There is no direct evidence to prove the statement that *all* erysipelatous diseases are dangerous; but it is more than probable that erysipelas, following severe bruises in transportation, should be very sharply looked after by our health officers.

Mr. Lindsay, whose experience as inspector at Pittsburg entitles his opinions to great weight, states that a few hours even are sufficient to produce a poison throughout the entire system of a severely bruised animal. Especially should we be on our guard against creatures that have been trampled to death, and either butchered for the market, or "tried out" for their tallow, as erysipelas of an aggravated form is apt to be present.

The *Texas cattle disease*, or splenic fever, which caused so much destruction to American herds six years ago, apparently is developed in a chronic, mild or latent form in cattle feeding on low, undrained land in certain parts of our southern seaboard States. If brought rapidly to the North, they communicate the disease in an acute and very fatal form to cattle which eat food or drink water contaminated by their excretions (Report to the United States Commissioners of Agriculture, 1871), although not themselves subject to the acute form of the disease unless they have first remained in the Northern States long enough to become acclimated, and then become exposed to the contagious matter, whatever it is, of freshly arrived herds.

In many of our large cities, the meat of such animals was sold and eaten in large quantities, without any marked evil results being clearly traced to its consumption, and that, too, although the disease was of such severity that cattle often died twelve hours after the attack. Nevertheless, in New York, the Board of Health attributed "the rapidly increasing

mortality from diarrhœal disorders, and especially the suddenness of death, in adults as well as in children," in 1868, partly to its use as food; and they gave it as their opinion that the flesh of animals affected either with the acute or chronic form of the disease, should not be sold as food for man.

As a result of his investigations on splenic fever for the United States Commissioners of Agriculture, Mr. Dodge says: "While meat of diseased animals can never be deemed wholesome food, the milk and flesh of cattle affected with this disease do not generally cause immediate sickness"; and Mr. Eaton also says of a quite fatal epidemic in Illinois, "not a single case of disease or injury resulted from the use of meat or milk."

Prof. Gamgee, too, of London, in his report on this disease to the United States Commissioners of Agriculture, in 1871, speaks as follows: "I was called upon a fortnight ago to reply to the question whether, if any of the flesh of the sick animals happened to be sold, it was probable that human beings might suffer. I unhesitatingly asserted what I repeat now, that the meat is not poisonous, and is incapable of injuring human beings. To that opinion I now adhere."

At the same time, he qualifies his statement in these terms: "If I should be asked what regulations should be made by city authorities in relation to the traffic in diseased meat, I have simply to declare what I have said for many years past; viz., that it is impossible to draw a line between health and disease, except as the two conditions are known to medical men; and, notwithstanding the apparent disadvantages of condemning more meat than there is any necessity for, it is essential that a sanitary officer should be supported on the broad general principle that a diseased animal is an animal unfit for human consumption."

Under the influence of excitement, lack of food, overcrowding and the various conditions of torture incident to their passage from the fields of Texas to the markets of our Northern cities, some bullocks have shown symptoms of the acute disease. In about a month after leaving their native pastures, cattle infected with the latent form of the disease become acclimated under the new conditions of life, and lose the power of communicating the acute form to Northern herds.

Cold weather destroys the infectious virus, whatever that may be.

Another *enzoötic* disease peculiar to the Alleghany Mountains, to certain parts of Illinois and the Mississippi Valley, is the "milk sickness" or "trembles," popularly so called, the pathology of which is not yet accurately known. It originates in low woodland districts, and may possibly be due, in some degree, to certain poisonous plants found in the infected localities. Quite serious illness is caused by eating the flesh, or milk, or even cheese made of the milk, of affected animals.

Prof. Cressy has known choleraic diarrhœa to be caused by eating the flesh of cows slaughtered while suffering from *parturition fever*, and Prof. Gamgee confirms this testimony.

The "hog-cholera," * and "spotted typhus," * called in Germany *Typhoeser Rothlauf*, and a disease said to resemble scarlet fever (? *Einfacher Rothlauf*), occur in pigs; and it is strange to say that such meat has been eaten without any manifestation of untoward results. The flesh of the former should *always* be condemned, and, in Germany, parts of the latter are cut off and also condemned.

With the *small-pox* of sheep, † the case is different. The flesh of affected animals is pale, moist, emitting a nauseous odor, and almost invariably giving rise to sickness in people who eat it.

When an enlarged humanity teaches us to fatten our horses for the market, instead of working them to death, ‡ it may be well to remember that the disease most common in them is the *glanders*. Decroix states that hundreds of horses so diseased were eaten during the siege of Paris, with no apparent ill result, and that he had himself eaten such without an

* These are, perhaps, popular names for erysipelatous diseases of different degrees of severity, but their pathology is not clearly made out.

† For accounts of epidemics of this disease in the United States, see the Reports of the Commissioners of Agriculture.

‡ Five thousand are eaten each year in Paris. There are several markets in Berlin for the sale of horse-flesh, which is sold more or less in sixteen different states of Europe; and butter, of especially delicate flavor, has been made of the fat of horses.

unpleasant symptom following. It may be fairly questioned, however, whether the immunity in these cases was not rather apparent than real.

DISEASED MEAT IN GENERAL.

In one of our towns in Massachusetts, many families were made ill from eating meat which did not look suspicious, but came from a sick bull.

In Genoa, when diseased meat was sold, it is said that epidemics were severe and gangrene common; and many cases of illness have been reported in Edinburgh from eating steaks from diseased animals.

When the plague started from its foul nest in Barbary, last year, an investigation by the English government proved, among other facts, that those natives who ate of the flesh of sheep affected with carbuncular sores suffered soonest and the most severely from the disease.

Dr. Letheby has (in 1860) investigated a case where, of sixty-six people who ate diseased meat, sixty-four were attacked with more or less severe diarrhœa, vomiting and prostration, and one died.

Prof. Gamgee asserts that about one-fifth of all the meat sold in London markets, ten years ago, came from animals more or less diseased, and he also says, "Dead-meat markets supply diseased meat for all, and not for the poor alone, as some suspect."

Prof. Danforth, of Chicago, writes: "I have several times found beef upon my table which was abnormally tender, yet fresh apparently. In these cases, the microscope showed the muscular fibre to be in a state of fatty degeneration, similar to what has been found in experimental starvation."

Prof. Cressy says that the "traffic in diseased milk and meat in this country is now immense," and he attributes very bad consequences to their use.

Prof. Cameron, of Dublin, traces many cases of illness to diseased meat; and one of our correspondents in this State writes: "Of this I am certain, that much meat of very inferior quality is sold here to the laboring classes, but can point to no positive ill result, except indigestion."

The extreme difficulty of tracing all disease to its source,* and the absence of exact experiments in regard to diseased meat, should make us very slow in saying that what causes serious results in so many cases is attended with more than apparent immunity in others, even if more numerous.

"It is by no means improbable that among the poor of large cities the secret sale of decomposed and unwholesome meat is a very frequent cause of disease and death." (Dr. Taylor, *Med. Jurisprud.*)

It should be remarked, too, that diseased meat decomposes with remarkable rapidity, thereby doubling the chances of evil results.

"Seeing that serious consequences may ensue [from eating diseased meat], it is only right to look upon all such meat as unsafe and unfit for human food" (Dr. Pavy); and, after reviewing all the testimony in favor of its apparent innocuousness, Dr. Parkes states that, "Animal poisons may be neutralized or destroyed by cooking or digestion, but the composition of muscle must exert an influence on the composition of our nitrogenous tissues which no preparation or digestion can remove."

Dr. Brown, of New Haven, writes: "It seems to me that no line can be drawn as to where or when meat becomes injurious or bad. From that which is certainly wholesome to that which is certainly bad, there is a regular gradation. . . . A certain meat in questionable condition might not illy affect one person eating it, while it would another."

TESTS OF DISEASED MEAT.

Diseased meat is often of a light pink color, soft instead of resistant to the touch, and generally loses more than twenty-five per cent. of its weight in cooking. The experience of sanitary officers the world over, however, proves that, in the majority of cases, inspection at the slaughter-house is absolutely necessary in order to exclude diseased meats, even of the most dangerous kind, from our markets. The testimony on this point is simply overwhelming.

* The late Dr. John Ware used to say that three-fourths of his patients got sick and got well again without his ever knowing what ailed them.

SEVERELY BRUISED MEAT.

The flesh of animals that have been trampled nearly, if not quite, to death, or in which erysipelas has supervened upon an injury, is sometimes of a dark purple tint, and is properly considered diseased.

The testimony of butchers and of health officers at hearings in this city, in 1871, and in London, in 1873, establishes beyond a doubt the fact that it is not in all cases possible to detect such meat from simple inspection of the carcass; and members of this Board have recently seen in small slaughter-houses in Brighton, two animals in regard to which it was impossible to speak definitely on this point.

EFFECTS OF STARVING.

A condition analagous to disease is produced by starving, and the medical inspector of the District of Columbia calls attention to the fraud upon the community from the sale of such meat. The Board of Health of New York has reported cases of inflammation of the stomach in steers, with high fever, dependent on this cause; and the streets of New York, St. Louis, and Indianola have not infrequently borne witness to the furious delirium of starved cattle, while Claude Bernard has shown that the amount of blood in artificially-starved animals is diminished by about one-half. The testimony of a butcher, doing a large business in London, is, that "if a bullock is left without hay or water for a day, that bullock loses some ten shillings in quality, and it loses in weight." He also says that he gives this as an accepted calculation among butchers, and not as his individual opinion.* And yet food recently absorbed into the system, within a very few hours before slaughter, passes quickly into decomposition, and taints a whole carcass.

MEAT FROM VERY YOUNG ANIMALS.

Very young meat can hardly be said to be absolutely injurious,† unless it be also diseased (as is too often the case)

* Report, etc., on Noxious Trades. London, 1873.

† French and English butchers have told me that foetal calves are removed from slaughtered cows, and are considered quite as delicacies by certain of the Jews in

by exhaustion, lack of food and drink, and suffering of various kinds. It possesses, however, very little nutritive value, is not readily digested, and is very generally condemned. Different countries or cities place the lowest age at which it may be sold at various points between two and six weeks.

SALTED OR PICKLED MEAT.

Many of the inferior qualities of meat are salted or "cured" in brine, processes which withdraw water, and with it the soluble phosphates and albumen and myosin and extractive matter from the flesh, and therefore deteriorate its nutritive qualities very decidedly.

BAD MEAT EASILY SOLD.

The ease with which diseased, dead, dying, very young or even foetal calves, can be dressed and smuggled to the Bologna-sausage maker, where they are prepared for sale away from supervision, can readily be seen in the neighborhood of Boston; and in order to convince one's self that sick, starved, maimed, dying and dead animals reach our cities, not in very great numbers indeed, every week, it is only necessary to inspect a cattle-train as it arrives from the West. If one asks at the various rendering-establishments whether *they* get such animals, the answer, "Yes—sometimes," compels the inference so strongly brought out by the examination in regard to the sale of bad meat in Boston, in 1871, that such meat is sometimes sold for food in our markets; and we are now absolutely powerless to prevent it, as we have no system of inspection. *Inspection*, and *nothing but inspection*, can prevent this.

EFFECTS OF TERROR.

How much animals suffer from the sight of suffering in others, if not actually in physical pain themselves, and how far they are capable of anticipating torture, are still matters of dispute. Many, if not most butchers think (and it is natural that they should think so), either that all animals, or that the least intelligent of them, are entirely indifferent to

Europe; and, under the name of "slunk veal," or "staggering bob," they are relished by the peasantry of Ireland. In neither case have I been able to find any mention of bad results from eating such meat.

unpleasant sights and sounds; but there is in the community a more or less strong feeling to the contrary; and in some cities especial pains are taken to prevent any blood or any of the processes of slaughtering from being seen by animals awaiting their turn.*

Various statements have been made of the general injurious effect of terror upon the secretions of animals (and by inference upon their flesh also); although I have not been able to find any proof that such influences, when uncomplicated, do more than diminish the quantity of milk, etc., without altering the quality.†

The importance of keeping milch cows free from disturbing emotions is well known to dairymen; and the flesh of animals is said by many stock-raisers to differ as food according to the general care, freedom from emotional disturbances,

* At the two large abattoirs in Lyons, the guards are required to enforce a law to this effect, and it is thought that the flesh of cattle is injured by allowing them to witness the slaughtering of other animals. At Zürich a leathern strap is slipped over the animal's horns, completely covering the eyes, before he is taken into the slaughterhouse. In the centre of this strap is a perforated iron block, the hole being directly over the centre of the forehead. Standing in this hole is a short, sharp, hollow steel spike, which is driven into the brain by a single blow of a heavy hammer, producing instant unconsciousness. The base of the brain is then at once broken up by means of a small iron rod, producing absolute death; the large blood-vessels are then severed. [S. H. M. Byers, U. S. Consul.]

At the abattoir at Providence, R. I., and at several other places in the United States, the following practice prevails for killing unmanageable steers. Each bullock in turn is driven into a small pen, while a man standing above its head severs the spinal-cord (*if the animal remains still*), by a single skilful stroke with a long, heavy iron spear, and the animal falls as if shot. This, the Spanish method, if performed as in Spain and in Naples, where the animal is in an inclosure so small as to prevent his moving about, is very swift and certain. As often practised in this country, it is very cruel, from the fact that the pens are too large, the animals run about more or less, aim is uncertain, and death slow and painful.

At Springfield and Lowell, Mass., and in some other cities, cattle are shot one by one.

In England, Scotland, and Ireland the law requires that large animals shall be killed with the *pole-axe*, which perforates the skull at the first stroke; and inspectors are required to enforce the acts for the prevention of cruelty.

In America, the more or less clumsy and inhumane method used by the Greeks of Homer's time is quite generally prevalent, and consists in first stunning the animal by one or more blows, well or ill directed, on the head. The throat is then cut, as is done in all the above cases. The Jewish method (stringing up by the hind leg and cutting the throat) is also used to some extent in the United States, but, from the cruelty involved in it, is generally condemned by those with whom it forms no part of a time-honored rite. (See note, p. 181.)

† "In a cow giving milk, there is no doubt that the secretion may be arrested or diminished in quantity by terror or other depressing emotions. The instances related of similar causes producing a deleterious change in the *quality* of the milk are less authentic."—*Dr. J. C. Dalton*.

diet, etc., which they have enjoyed during life, although the microscope and chemistry do not at present aid us in saying why it should be so.

In London, in 1873, a prominent butcher even testified that "inferiority and want of skill in slaughtering injure the value of the animal slaughtered"; and another stated that "the more care the things are killed with, the longer they keep."

The evidence collected from sixty-five correspondents in different parts of the world, being for the most part members of Boards of Health, who have had especial opportunities for observation, is as follows:—

Three state that secretions are so altered in animals by terror as to render their "milk or flesh" injurious as food, but they give no facts in support of their theories.*

One thinks that the flesh is affected, and that it putrefies early.

Fourteen think that terror, if prolonged or excessive or accompanied by exertion, would injure the meat.

Fourteen think that animals do not suffer from terror in slaughter-houses.

Ten think that they do so suffer, but doubt whether their flesh is injuriously affected.

Nine think that terror cannot injure flesh.

Seventeen are unable to give any opinion, although having had excellent opportunities for observation.

An eminent physician at Frankfort-on-the-Main, occupying a high position in the *Sanitätsconsilium*, states that he cannot find in any German or French publication any intimation that the terror or trembling witnessed in the slaughtering affects injuriously the flesh of animals.

The following opinions are from eminent members of Boards of Health:—

"The flesh can be altered by terror only when violent exertions (heftige Bewegungen) accompany it."—(*Ghent.*)

"It is generally supposed that animals suffer somewhat from terror. The butchers, however, declare that the flesh is not injuriously affected from their seeing the various processes of slaughtering."—(*Zürich.*)

* Of these three, one knows no facts, one "knows facts," but has not answered inquiries as to what they are, and the third does not state whether he refers to milk, or to meat, or to both.

"I believe cattle do suffer from terror, but swine and other animals do not. I do not think the flesh is injuriously affected, at least not to any great extent."—(*Pittsburg.*)

Animals "become excited and terrified if present at the butchering. If allowed to stand over three or four hours, the flesh would be injuriously affected."—(*Baton Rouge.*)

"It is natural to suppose that they suffer from terror; but to what extent their flesh is injuriously affected, an opinion, if expressed, would be only conjectural; but we incline to the opinion that its value would be seriously impaired."—(*Richmond.*)

"It is supposed that animals suffer from terror, but it is not generally the opinion of meat dealers that mere terror, independent of physical exertions, injures the qualities of their meat as food."—(*Des Moines.*)

"I have seen animals terrified; but I do not think that mere terror, unaccompanied by violent muscular exertion, would affect the quality of their flesh."—(*Dublin.*)

"It is supposed that animals suffer from terror, but I do not think it affects the flesh, except when furious. It is then much darker in color."—(*Leith.*)

"It [terror] has a tendency to set them wild, and the meat is liable to putrefy."—(*Belfast, Ireland.*)

"Prolonged terror must prove injurious, but I can adduce no facts."—(*Belfast, Ireland.*)

"I think it not improbable that milk secreted shortly after an animal has been greatly terrified would be unwholesome. I cannot give any opinion as to the effect of terror upon meat."—(*London.*)

"I believe that terror, if prolonged or repeated, is liable to render the milk injurious, but that it has no substantial effect upon the flesh, unless it should be in degree and duration beyond all probable limits."—(*Atlanta.*)

"Cases of apparent injury [from terror] can always be explained by unsuspected disease."—(*Baltimore.*)

"Mental emotion, in my opinion, produces changes in both the milk and meat."—(*Nashville.*)

"The affirmative is demonstrated as respects secretions; evidence respecting meats cannot be entirely conclusive."—(*New York.*)

"Terror may dangerously vitiate the milk of cows. That the flesh should be injured by the same cause is less evident; for such an effect I should suppose *prolonged* or *often repeated* as well as extreme alarm must be necessary."—(*Philadelphia.*)*

* At the new abattoir in Jersey City, where 200,000 cattle and 300,000 sheep are killed yearly (although not working at more than one-half its full capacity), the eighty pens are separated simply by open iron railings, so that everything is in open

A leading butcher in Washington gives the following opinion, but it is only fair to say that few others agree with him :—

“Every practical butcher knows by experience that an animal being terrified before slaughtering will cause its meat to present a bloody and puffed appearance.”

EFFECTS OF EXHAUSTION.

Although, during our late war, many medical inspectors saw animals killed immediately after a long march, and while overheated, without any evident ill effects in those who ate the flesh,* and although wild creatures are often killed under more or less similar conditions, yet there are many facts to prove that the flesh of such animals is at times injurious. Medical-Inspector Hamlin states, as a result of his extensive experience, that such meat is deleterious. Old hunters make special efforts to prevent their dogs from “worrying” game, and many prefer the deer shot quietly at night to that killed under the excitement of the chase.

One of our correspondents in Massachusetts says : “A beef was slaughtered in our town that had to be supported to the abattoir exhausted from overdriving. The meat tainted, under favorable circumstances for preservation, in less than twenty-four hours.” And another writes : “I have known of one case of an overheated ox which was slaughtered. The meat was dark in color, and became tainted in a few hours.”

“The flesh of animals that have been excited before death, as by overdriving or by torture, has frequently proved unwholesome.”—(*Letheby*.)

Dr. W. Holbrook, of Palmer, Mass., says :—

“I know from my army experience, that the flesh of overdriven cattle in hot weather produces diarrhœa and dysentery. As surgeon-in-chief, I have refused to have a single pound issued with the troops on the march. When eaten, fermentation resulted, and not digestion; and with tired men, diarrhœa and dysentery were the direct results.”

view. The advantages which were expected from this plan were light, air and *scrupulous cleanliness*, in which it is certainly a model; but experience has also shown that the animals, although frequently trembling, are unusually quiet and docile in appearance and conduct. This stillness has been thought by some observers to be possibly due to their being completely terrified, or in a measure paralyzed from terror. The clean and dry stock-yards, the well-filled mangers and watering-troughs, and the comfortable sheds for protection from the weather testify that the company is not wanting in humanity.

* In the new abattoir at Dresden, Saxony, animals are not of necessity absolutely condemned as unfit for food when they are killed to save their dying from exhaustion.

We have the high authority of Liebig for the statement that five persons were once made seriously ill by eating the flesh of an animal which had struggled violently in a snare for some hours immediately before being killed.

"There have been cases known where symptoms of poisoning have resulted from the eating of game which had been greatly distressed and worried before death; also from the eating of the meat of animals that had undergone long marches directly before being slaughtered."—(*Pappenheim.*)

"A poison pervades the tissues of cattle that have been driven, of others exhausted by disease, of cows and other animals slaughtered after many hours of difficult labor, and of those dying of parturition fever, . . . and abroad attention is paid that animals be rested. . . . The meat (of such animals) cooked has induced colic, thirst, vertigo, debility, and at times death."—(*Prof. Gamgee.*)

The testimony of a butcher in regard to London slaughter-houses is, that "you cannot injure an animal while alive without its showing it when dead." And, finally, at a meeting of butchers in this State, not one was willing to say publicly before the others, that he would offer for sale for human food an ox that had been slaughtered while overheated, and excited by very violent exertion of considerable duration.*

EFFECTS OF ARTICLES OF FOOD.

The effect of deleterious articles of food or of medicine upon the flesh of animals is more easily traced; and arsenic and antimony, used even as external applications, have produced bad symptoms in those who ate the flesh, even of parts remote from the points of application, of animals so treated.

Three hundred and one persons once ate of the meat of an ox that had taken two ounces of tartar-emetic before being slaughtered; of these, one hundred and seven suffered from vomiting and purging, and one died. Antimony was found in the tissues of the ox, and in the stomach of the man who died (*Dr. Kreutzer*).

* I am indebted to Dr. Cabell for the following remarkable fact:—It is the custom of many butchers in Virginia, just before killing beeves for the market, especially if they be old, to have them run for two or three hours by dogs; and they say that it has the effect of making the meat more tender.

Lead has been known to be so taken up by the tissues of plants, as to give rise to symptoms of poisoning in the cattle eating them.* The epicure can readily detect the taste of turnips in mutton; and the canvas-back duck is thought to gain its fine flavor from marine plants on which it feeds. This question is especially interesting to us in respect to hogs, which are so often fed on all kinds of refuse. They have sometimes died from the effects of drinking the milk of diseased cows (Prof. Cameron, of Dublin), diseased meat has proved fatal to them, and they become diseased by eating unsound grain, putrid meat, or even from an exclusive diet of fresh animal food.

Pappenheim states, unequivocally, that feeding swine with putrid animal matter produces poisonous food.

Dr. Parkes and others have remarked, in regiments in India, that pork produced diarrhœa among the soldiers, when no cause for it could be ascertained, except that the hogs had fed on offal not always fresh.

"Sows fed on flesh give birth to pigs which cannot be reared, but die shortly after being born. If very young pigs are admitted to the flesh diet they also soon die. Pigs of two or three months old seem to thrive on flesh, although the mortality among them is sometimes considerable. Pigs fed on flesh have a peculiarly soft diffuent fat, emit a strong odor from their bodies, and, after death, putrefy more rapidly than others." †

The loathsome disease produced in milch cattle by feeding them exclusively on "swill" is too familiar to us, through our daily papers, to require more than a passing notice.

AMOUNT OF MEAT CONDEMNED.

During the past year there were condemned—

At Chicago: 611 quarters of beef, 166 carcasses of mutton, 107 calves, 7 hogs, etc., etc.

At New York: 20 cattle, 1,103 calves (997 less than a month old), 268 sheep and 50 lambs, 293 hogs, 39 tons of meat.

At Pittsburg: ‡ 27 cattle, 35 sheep, 10 tons of meat.

* Taylor on Poisons, p. 512.

† Fifth Report of the Medical Officer of the Privy Council, London, 1863. This statement refers to animals fed exclusively on flesh. There is no evidence to prove that a mixed diet, containing meat or offal, injures hogs in any way.

‡ This does not include the animals dead at the stock yards, or killed in transporta-

At Washington, during the latter half of the year : 6 cattle, 8 sheep, 11 calves, 1 hog, 7 tons of meat.

In London an average of 100 tons of meat is condemned yearly.

The inspectors of New Orleans and Pittsburg call especial attention to the fact that the quality of meat had very much improved since inspection previous to slaughter had been insisted upon.

The conclusion is unavoidable, that large quantities of meat, unsuitable for human food, are sold in all large cities, where there is no rigid system of inspection before and after slaughtering.

STANDARD FOR CONDEMNING MEAT.

The question as to what meat should be condemned has generally been answered on the broad ground that no diseased meat is fit for human food. In London, the health officer requires to be seized "the flesh of all animals infected with parasitic diseases, of animals that may have been suffering from acute, febrile or wasting diseases, and of those which have died from natural causes or by accident, as well as all meat tainted with physic or in a high state of putrefaction." *

At Bâle, during the past year, animals were condemned on account of endocarditis, pyæmia, degeneration of the lungs and of the liver (phthisical), peritonitis, abscesses, erysipelas, parasitic disease, death from suffocation, and dropsy. Calves less than two weeks old are condemned entirely ; those between two and three weeks of age, may be sold for sausages, and all others, if not diseased, go to the markets.

The internal organs alone were condemned of animals in the early stages of pulmonary consumption, of those in whom hydatids were found, and of animals with superficial erysipelas.† It will be seen that none were absolutely condemned on account of simple inflammatory disease or in the early stages of chronic disease. The meat is classified, however, and only perfectly sound, young, fat meat can be sold as of first quality.

tion, and amounting to 551 cattle, or 0.124 per cent. of the whole number transported; 4,410 hogs, or 0.51 per cent. of the whole number transported; 1,173 sheep, or 0.15 per cent. of the whole number transported.

* Letheby, On Food; London, 1874.

† Dr. F. Mueller.

Opinion on the continent and in England seems to be tending in this direction, that all meat which is known to be injurious should be sweepingly condemned, and that all other should be rated of different qualities.*

"Meat, the normal physical characters of which are altered by these diseases [febrile and emaciating], is not only wanting in the nutritious qualities which it should possess, but is liable to be indigestible or to produce diarrhœa. I am of opinion that it is very questionable whether the meat from animals in the early stages of febrile diseases is *per se* injurious at all. It is, however, to be recollected that such meat quickly undergoes chemical change (decomposition in some form), and that then it may become injurious; and there is some probability that the unwholesomeness from this cause may precede the actual manifestation of ordinary putridity. Practically, then, such meat ought not to be regarded as sound in the same way as the meat from animals not in a febrile state. It might, on economic grounds, be unwise to prohibit altogether the sale for food of such meat; but in my opinion the slaughtering and sale should be effected under supervision. The animal should be thoroughly bled, and the meat should be at once cooked and sold in the cooked condition."†

Dr. Letheby, referring to the imperfect system of inspection necessary among the fifteen hundred slaughter-houses which are scattered over London, says:—

"We are either condemning large quantities of meat which may be eaten with safety, and are therefore confiscating property and lessening the supply of food, or we are permitting unwholesome meat to pass almost unchallenged in the markets."

Dr. T. K. Chambers says:—

"I feel sure that great waste of assimilable food arises from the destruction of damaged meat. It should be sold properly labelled, at a low price; and the passing it off as good meat made a fraud under the adulteration act."

The English army is supplied by law with only sound, healthy meat. In time of war, Prof. Parkes directs inspectors that they should allow the issue of the meat of all animals ill with inflammatory and contagious diseases, with the exception of small-pox and, perhaps, splenic apoplexy,‡ taking care, however, that the animals be bled thoroughly, that only the flesh and no internal organs be eaten, and that

* Two grades would be sufficient, as in France.

† Dr. E. Ballard, Med. Officer for Islington, London. Compare also his article on "Diseased Meat and Public Health," Brit. & For. Med. Chir. Review, vol. XXI, 1858.

‡ Practical Hygiene, 1873, p. 202.

the meat be well cooked. This course he recommends as a less evil than being without animal food entirely.

REMEDIES.—INSPECTION.

In the facts presented there are surely grounds for the suspicion expressed a short time ago by one of our most careful and eminent observers, that "we are a much meat-poisoned people"; and the question arises, How shall we rid ourselves of the evil?

While, on the one hand, the community overrates the actual dangers arising from eating the meat from diseased animals, as shown by the great diminution in the sale of all meat when disease is especially prevalent among cattle, on the other hand we vastly underrate the very great importance of having all kinds of food, meat included, perfectly pure and adapted to our ever-varying conditions.

If bad meat produces no ill results in certain individuals, it may do so in others; or, it may be eaten with impunity by a person while in vigorous health, who, if tired or ill, could not eat it without suffering some injury.

So much has been said of late of the misery produced by the injudicious and improper use of alcoholic drinks, that we have almost entirely overlooked the equally important question of the use of improper food.

We search the four quarters of the globe for materials with which to build our muscles, and bones, and nerves, and brains, and yet very little careful consideration is needed to show that we do our work often with a carelessness that would be considered criminal in the architect of a public hall.

Up to a certain point, the intelligent classes can protect themselves from the evil influences of bad meat, although they often do not see it until it is served on their tables. Beyond that point, and in all cases with the uneducated classes, it is the duty of society to interfere between the cupidity and ignorance of unscrupulous dealers on the one hand, and the ignorance and helplessness of the people on the other. This can only be done by a careful system of *inspection*.

Such a course would be welcomed by the best butchers, who desire to sell only sound and wholesome food. They are, in-

deed, themselves often imposed upon in their purchases of animals; and, at Pittsburg, where inspection before slaughter has been insisted upon for some years, they at times apply to the inspector for his opinion before buying. If butchering badly-bruised, trampled, exhausted and diseased animals for the market were restricted by law, greater care would be taken in their transportation, and they would be brought to our markets in better condition, provided the law were enforced.

Dealers in stock would find it for their interest, too, to prevent disease, the facility with which they can now impose upon the community tending to foster a spirit of apathy or neglect, whereby animals are kept on ill-drained or infected pastures, in badly-ventilated barns, with poor food, and bad water, etc., conditions directly causing disease.

In cases of gross fraud or violation of the law, there might be a penalty even to losing one's license, as in Berlin; or if there be a forfeiture in money, the informer might have a part, as suggested by a prominent butcher at the hearing in Boston on the sale of bad meat; or the names and addresses of convicted parties, with the fines imposed, might be published, as is done in Dublin.

It is not possible to inspect every animal at the time of slaughter without a large corps of inspectors, or an unjustifiable amount of interference with private business; nor is that necessary. Every creature might be inspected within twenty-four hours of the time of slaughter, and all doubtful ones might be marked to be examined again carefully with the internal organs.

Without a system of rigid and frequent inspection, slaughter-houses cannot be prevented from becoming unclean, and a nuisance to their neighborhood;* nor can animals be insured proper food and humane treatment. We are simply putting the evil out of our sight and not correcting it, by having our cattle transported to a distant city for slaughter without inspection. About one-tenth of the meat sold to the

* Compare the experience of the Board of Health of New York, in this respect. Reports, 1871 *et seq.*

The old abattoirs in Berlin became exceedingly dangerous and filthy, simply from want of proper care and inspection; so that petitions were sent to the officers of the government for their abatement.—[Der neue Berliner Viehmarkt; Dr. Langmann.]

six hundred thousand people now supplied by the Boston markets during the winter time is brought dressed from the Western cities; of this quantity about one-third is probably as good as any we eat, although there is some difference of opinion both in this country and in England as to the length of time that it will keep fresh. Much of the remainder as thoroughly demands inspection as any meat well can. A large part of it is from animals that are sold at very low rates in Chicago, some of it at \$1.75 per hundred pounds on the hoof; and the animals are so miserable in many cases, that no one would buy them for transportation to the Eastern cities, if, indeed, there were any probability of their living to get there.

RULES FOR THE MANAGEMENT OF SLAUGHTER-HOUSES.

What, then, are the requirements of every slaughter-house?

First. Absolute cleanliness, both to avoid offence to people living in the vicinity and to prevent early putrefactive changes in the butchered meat.*

Second. Animals should be provided with suitable shelter and abundant food and water. It is better that they should not be fed, however, within six or eight hours of the time of slaughter, as recently absorbed food promotes early decomposition.

Third. Should overdriving, exhaustion, etc., be unavoidable, there ought to be (as in Europe), if practicable, a rest of several days, or at least of one day, to allow the feverish tissues to reassume their condition of health. The testimony is almost universal that a feverish condition in cattle is incompatible with *thorough* wholesomeness of the flesh; and, even where it is customary to kill creatures immediately after a long journey, the butcher who wants meat for his own use picks out an animal and lets him rest a few days before killing him.†

* "The putrid emanations from bad slaughter-houses are such that meat cannot be long kept in them or in shops adjoining them" (Fifth Report of the Medical Officer of the Privy Council, London). Nor must it be forgotten that a low temperature does not always prevent meat from being contaminated while exposed to air vitiated by decaying animal matter.

† *Thoroughly* exhausted animals, at the stock-yards in Berlin, are removed and slaughtered by a butcher of the police. Such parts as may be found still fit for food are given up to the owners, and the remainder is carried to the public flaying establishment.

Fourth. It is quite generally acknowledged that the best way to kill animals for the market is that which is the quickest, the most painless, which secures the complete removal of the blood from the body, and which does not excite or harass them.

Unnecessary cruelty* (in a sense, a certain amount of cru-

*By the "Berichte des Sanitaetsconsiliums von Basel-Stadt vom Jahr, 1870," I find that the proprietor of a slaughter-house and some butchers have been fined for avoidable cruelty in killing cattle in that city.

In speaking of our method of slaughter, which obtains also in many parts of Germany, Mr. Kreismann, U. S. Consul-General at Berlin, says: "This frequently requires from ten to fifteen blows before the animal is killed, and is attended by circumstances making it brutal. Efforts, therefore, are being made to substitute a method of slaughtering by means of the *bouterolle à la masque*," recently invented by Bruneau, of Paris, and improved by Leykauf of Nuremberg, under the name of *Schlachtmaske*, or *slaughtering-mask*. This slaughtering-mask has been tried in Berlin, Dresden, Vienna, Frankfort-on-the-Main, and in France, with most gratifying success, and has already been described as being in use at Zürich (see note, p. 170). If necessary, a small rod is thrust through the perforation in the skull, destroying the base of the brain completely. In the "Dresdner Nachrichten," of Oct. 29, 1874, for which I am indebted to L. Brentano, Esq., U. S. Consul at Dresden, is a detailed account of the mask, calling attention to the cruelty of the present mode of slaughtering, and to the painless and instantaneous death accomplished by the new method. The "Frankfurter Beobachter," of Sept. 6, 1874, speaks of the fact that the wildest and most ungovernable animals are thus rendered quiet and manageable. In the "Nürnberger Presse," of Aug. 15, the editor sums up the advantages of this mask as follows: *First.* The duration of suffering is reduced almost to nothing. *Second.* The flesh and internal organs are in better condition.



Third. The brain is natural in appearance, not congested.

Fourth. Less strength and less exposure to danger of being injured are necessary on the part of the butchers.

Its compulsory use is strongly recommended.

Louis Moll, Esq., president of the society for the prevention of cruelty to animals in Koenigsberg, Prussia, states that his society has "provided these *bouterolles* and strongly advocates their general introduction, as best calculated to relieve animals from the terrible and protracted sufferings they formerly had to undergo in the process of being killed." He sends also the accompanying wood-cut.

elty is involved in the very act of killing) should always be avoided on account of its possibly baneful influences on the animals themselves, on the ground of humanity, and because it demoralizes and degrades a community which suffers it.

Fifth. All offal should be kept in closed receptacles, and removed before putrefaction has begun,—a process for which six hours is often sufficient in summer.

Sixth. No hogs should be allowed to live on the offal.

1. Because hogs feeding on the refuse of animals are under circumstances favorable for spreading parasitic diseases.

2. Because the flesh of such hogs is unwholesome.*

3. Because a nuisance is thereby created from the accumulated fifth.

In many cities this rule is rigidly enforced.

Seventh. All parasites of whatever kind should be destroyed, with the flesh or organs containing them or not, as each case may require.

Eighth. No slaughter-house should be permitted close to dwellings or public highways.†

Ninth. All butchers should receive licenses, to be revoked at once, in case they are detected violating the law;‡ and no person should be allowed to kill even small animals outside of licensed houses.§

Tenth. In large cities the inconveniences arising from killing animals for the market, and the nuisances from the various dependent businesses, are, by common consent, reduced to a minimum in abattoirs.||

Eleventh. Nothing further need be said of the necessity of daily inspection in cities and large towns, or wherever cattle

* Recent experiments in Germany have shown that if restricted to a diet of even fresh meat, they become diseased.

† In one town in Massachusetts, there is a large slaughter-house close to the public school; its influence on the education of the girls and boys must be far from favorable.

‡ As is already the practice in New York City.

§ One of our correspondents in Massachusetts states that, generally speaking, so far as his town is concerned, diseased meat when sold is dressed for the market in out-of-the-way places by people who are not butchers. It is to be remembered, however, that bad animals generally find their way to the cities, as the concealment necessary for killing and selling them is much less easy in small towns than in large cities.

|| The Prussian law of 1868 is a good one. It authorizes cities and towns to erect public abattoirs, and to make it obligatory to have all slaughtering done in them; also to have the animals as well as the meat inspected.

are received by rail, except that this is decidedly for the interest of those persons who wish to do business cleanly and honestly.

ADVANTAGES OF INSPECTION.

An intelligent inspector who is familiar with cattle and the details of transportation, might accomplish a great work, and by inspecting all animals before death, he would seldom let unwholesome meat slip through his hands. By correcting abuses in transportation; by seeing that no evil comes from infected trains and stock-yards in case of epidemic disease;* by seeing that food and water are supplied; by putting a stop to all cruel treatment as far as possible,—an inspector would return to the State many fold the small sum needed for his pay.

It cost Massachusetts \$70,000 to get rid of pleuro-pneumonia in cattle, and the laws of the State, passed to meet the emergency of a general outbreak of such diseases, are not excelled in efficiency and completeness in the world.

Would it not *pay* to do more to prevent disease in animals, deaths from transportation and the many evils arising from the sale of bad meat?

* Connected with the magnificent new abattoir in Berlin is a disinfecting department, and Dr. Langmann states that nothing further is needed to thoroughly purify transportation-cars, even in time of epidemics, than thorough washing with water at a temperature of 169° F.

THE BRIGHTON ABATTOIR, ETC.

- I. REPORT OF MR. J. N. MERIAM, *President of the Butchers' Slaughtering and Melting Association.*
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THE BRIGHTON ABATTOIR, ETC.

I.

REPORT OF MR. J. N. MERIAM,

PRESIDENT OF THE BUTCHERS' SLAUGHTERING AND MELTING ASSOCIATION.

To the Secretary of the State Board of Health.

DEAR SIR :—The directors instruct me to make the following report. The past year has been one of progress at the abattoir. Eighty thousand dollars have been expended in new buildings on the grounds of the Association, including two blocks of dwelling-houses, put up by members of the Association. Two blocks of slaughtering-houses have been erected upon the same general plan of the others, with such improvements as our experience suggested. The last block built is the largest, and, in its apartments, equal, if not superior, to any of those previously erected ; it is roomy, and will accommodate a large amount of work. There are now sixteen beef-slaughtering houses, whose full capacity is four hundred and fifty cattle a day.

With these additions, the Association has now provided facilities equal to the slaughtering of all the cattle, sheep and calves needed to supply the demands of Boston and vicinity. This will require that the work be so distributed that each house shall do something near its capacity. While the lessees of a number of the larger houses are now prepared to dress beef for other parties, to any extent that will probably be demanded of the Association, yet the time will come when another block will be called for, in order that each occupant may be allowed the privilege of doing only his own work. Fifty-three thousand four hundred and nineteen cattle, twelve thousand five hundred and thirty-six calves, three hundred

and three thousand two hundred and ten sheep, were slaughtered during the year ending December 31, 1874; of which twenty-one thousand three hundred and seventy-five cattle, one hundred and twenty-eight thousand four hundred and six sheep, and one hundred and forty-three calves, were slaughtered during the months of August, September, October and November. The heads, feet, blood and offal of these animals have been manufactured, at the rendering-house, into the several products of oil, grease, bones, hoofs and fertilizer. All of these products are of the very best quality, and find a ready sale at good prices. Only a part of the tallow produced at the abattoir has as yet been rendered at the works, much of it being taken away to small try-houses in and about Brighton.

This is all wrong, and we trust will very soon be remedied. All the rendering of tallow should be done at the rendering-house, where all necessary devices and appliances are in readiness to perform the work without offence. The same success has attended the process (performing it without offence) as resulted from the first year's experience. The rendering-house is ample for the accomplishment of all the work that will be required of it for many years. Plans are now being matured by which the soup from the rendering-tanks will be utilized, and this part of the work will be in operation within a few weeks.

A block of two tripe-houses, with stables, have been erected, and are now in process of completion. The foundations of a third house, also, have been laid, and are now waiting to receive the buildings, for which plans have been made and approved. When these buildings are finished and put in operation (which will be in the coming season), they will be sufficient to treat all this material produced at the abattoir.

A one-story building, three hundred and eighty feet long, to be used as a storehouse, has just been completed. Beside three new buildings, put up within the yard to accommodate the business, it was found necessary to make quite extensive alterations and additions in and to the rendering-house, to perfect the working of the system. A part of the columns were found to be too slender to support the weight required of them, and were replaced by larger ones. A new elevator,

one of the largest and finest in the State, has been added, to be used in delivering our products from the rendering-house. The machine repair-shop has been furnished with a complete set of tools, including lathes and drills. Tanks for rendering, and one additional dryer, and also a large triple press, have been put into the same building, making in all an outlay of ten thousand dollars. The yards have been enlarged, and now contain one hundred thousand square feet, and they have been covered with planking throughout, at a cost of six thousand two hundred dollars.

The grounds about the premises have been graded and improved. Two acres of new land have been made by filling, on an average of four feet, the marsh land lying along the banks of the river (all of which is now occupied by buildings, yards and driveways), at a cost of about four thousand two hundred dollars. Twenty-three hundred feet of drain-pipe, five hundred and twenty-five feet of heavy four-inch water-pipe, and twenty-one hundred and twenty-three feet of steam and small water-supply pipe, have been used during the year. Eight men or firms have come to do business at the abattoir within the year, making the total number, now slaughtering here, twenty-six.

We have been at work twenty months, during which time we have been perfecting our works, making additions to our accommodations, and laboring to make the abattoir, in all respects, a desirable and economical place for those engaged in slaughtering cattle and sheep, and preparing meat for the market. It now only remains, for all those interested, to avail themselves of the privilege here provided, in order to render the enterprise a complete success, both in a sanitary and financial point of view.

Respectfully yours,

J. N. MERIAM, *President.*

II.

REGULATIONS

FOR THE CONDUCT OF THE BUSINESS OF THE BUTCHERS' SLAUGHTERING AND MELTING ASSOCIATION.

[Presented by the Association, and approved by the State Board of Health at their meeting, October 1, 1873.]

I. There shall be a managing director, appointed by the Board of Directors, who shall have the general charge of the premises of the corporation, and of all work done on said premises, subject, however, to such rules and regulations as may from time to time be adopted by the corporation or imposed by the State Board of Health, conformably to the charter of the corporation.

II. Said managing director shall have the entire control over all assistants and employes of the corporation, and shall keep a constant supervision of the rendering-house and the basements of the slaughter-houses, and shall see that all rules and regulations of the corporation and of the State Board of Health are fully observed.

III. Every person occupying any slaughter-house, or killing or dressing any animal therein, shall, as soon as the animal is dressed, cause its offal, tallow, head and feet to be dropped through the openings in the floor which shall be designated for the purpose. Whenever any animal is killed, the blood-hole in the floor shall be opened, so that all blood may run through the same. The hides and tripe of beef-cattle shall also be dropped immediately through the respective openings provided for the purpose. While the killing is in progress, the water-hole in the trough shall be kept closed. After the killing is over, the blood-hole and all openings, except the water-hole, shall be closed. The water-hole shall be opened, and the floor and walls of the slaughter-house shall be thoroughly washed down.

IV. The corporation shall provide in the basement a sufficient number of properly-constructed wagons to receive the said offal, tallow, heads and feet, tripes, blood and hides. The managing director shall cause one of said wagons to be kept constantly under each opening in the floor, while any killing is going on, and until the slaughter-house floor is cleared up after such killing.

V. All hides shall be removed, under the direction of the managing director, to a part of the rendering-house to be called the "hide-room," where they shall be weighed and delivered to any person who shall have authority from the butcher to receive them for removal from the premises of the corporation; or, if the same are to be cured by the corporation, or on its premises, they shall be salted and taken care of under charge of the managing director.

VI. All tallow shall, in like manner, be removed to the rendering-house, and weighed and delivered to any person who shall have authority from the butcher to receive it for removal from the premises; or, if the same is to be rendered by the corporation, it shall be raised on the elevator to the rendering-room, and immediately rendered.

VII. All tripes shall be removed in like manner and delivered to the person authorized to receive them.

VIII. Any butcher who sells his hides or tallow for removal from the premises, shall notify the managing director of the name of the purchaser, and shall pay to the corporation his due proportion of the actual cost of the labor employed in removing said hides and tallow from the basement of the slaughter-house to the rendering-house, and of delivering the said hides and tallow to the said purchaser. He shall also take care that the purchaser of said hides and tallow shall come each day, at such time as shall be fixed by the managing director, with suitable wagons to receive and remove from the premises all hides and tallow ready for removal, so that no tallow or hides shall remain on the premises of the corporation, except such as are to be manufactured by said corporation, or on its premises.

IX. The corporation shall render all tallow that the persons hiring or occupying a slaughter-house on its premises shall request, and all that shall not be removed from the premises, as provided in the preceding regulation; and shall sell or cause to be sold all tallow so rendered; shall keep proper books of account, showing the weights and amounts received from the sales of the tallow of each butcher, and shall receive, for manufacturing and selling said tallow, such percentage of the proceeds of such sales as may be fixed by the directors of the corporation from time to time. But this regulation shall not prevent the corporation from buying of any butcher his crude tallow, at such price as may be agreed upon.

X. The corporation shall, in like manner, remove and render the heads and feet of all animals slaughtered on the premises, and shall pay for each set of heads and feet such prices as the directors may fix from time to time, subject to the approval of the State Board of Health, unless the parties shall agree upon a price.

XI. All blood and offal shall be forthwith removed from the basement of the slaughter-house to the rendering-house, and raised on the elevator to the proper story for manufacturing it. Offal shall be rendered while fresh, and the scrap of all offal and all blood shall be immediately dried. All blood and offal shall be the property of the corporation, and the manufactured fertilizers shall be properly packed and stored for sale by the corporation.

XII. Pelts of sheep shall be dropped into the basement under the slaughter-house, and removed every day.

XIII. All stables shall be kept clean and sweet. The corporation shall remove the manure from the stables and the yards as often as need be, to keep the said stables and yards inoffensive. The manure shall be the property of the corporation.

XIV. The corporation shall furnish the necessary power for hoisting, and the necessary hot and cold water for cleans-

ing the meat and the slaughter-houses, and also water for the stables and stock-yards. In the use of said machinery and water, the butcher shall exercise all reasonable care to avoid breaking the machinery and waste of water, or damage to the buildings.

XV. All leases shall be executed in the name of the corporation, by the president, and shall require the lessees to conform to the regulations which may be made from time to time by the corporation and the State Board of Health.

III.

COMMONWEALTH OF MASSACHUSETTS.

STATE BOARD OF HEALTH, }
BOSTON, July 30, 1874. }

In accordance with section 4, chapter 365, of the General Statutes, 1870, the following revised regulations have been adopted by the State Board of Health for the conduct of the business at the abattoir of the Butchers' Slaughtering and Melting Association; and strict compliance therewith, both on the part of the Association and of its individual tenants, will be insisted on and enforced by the Board.

By order of the State Board of Health,

F. W. DRAPER, M.D.,
Secretary pro tempore.

REGULATIONS.

1. Only animals in health shall be slaughtered for food.

Dead or diseased animals, when received in ordinary consignments of live-stock to persons slaughtering on the premises, may be prepared for rendering in the basements, and thence immediately transferred to the rendering-tanks and rendered.

2. No injury or unnecessary pain shall be inflicted on any animal at the premises of the Association.

An ample supply of food and water must be served to animals at seasonable times.

3. The occupants of slaughter-houses shall see that all parts of animals, slaughtered on their premises, are at once put in the places provided for their reception; that the offal, tallow, heads, feet, blood, hides and tripe are dropped, as soon as may be, through those openings in the floor, which are specially designed to receive them; that, while the killing is in progress, the blood-hole in the trough is kept open, and the water-hole is kept closed; and that, when the slaughtering is finished for the day, the water-hole is opened and all other holes are closed, and the floor and walls of the slaughter-house are thoroughly scraped, washed and cleaned.

The close-pens, cooling-rooms, loading-sheds, stables, and all other parts of the premises, must be kept clean and in orderly condition.

4. No parts of animals slaughtered elsewhere shall be brought to the premises of the Association, except by special permission of the State Board of Health, issued in writing.

Permission to bring blood or offal (except fresh heads and feet) will not be given in any case.

5. The corporation shall provide, in the basement, a sufficient number of properly-constructed wagons to receive the offal, tallow, heads, feet, blood, tripe and hides. One of said wagons must be constantly kept under each opening in the floor, while killing is going on, and until the slaughter-house floors are cleaned after the killing.

All parts of the slaughtered animals which are to be rendered, dried or salted, on the premises, must be so treated without delay.

All hides and skins, tallow or tripe, belonging to any tenant of the corporation, who desires to have them removed from the premises before being rendered, salted or cured, shall be so removed at once. In no case will such material be suffered to remain more than twelve hours before removal.

6. The corporation shall render all tallow produced on the premises that the persons hiring or occupying such premises

shall request, and all tallow that is not removed from the premises as provided in the last section of the preceding regulation. And after such rendering, the corporation shall return to each person his proportionate share of such rendered tallow, unless some other disposition of the same shall be mutually agreed upon. And all hides and skins, not removed as provided for in the last section of the preceding regulation, shall be salted by the corporation and returned to the owners. And the corporation shall receive for the rendering and salting, provided in this regulation, such compensation as shall from time to time be fixed by the directors, subject to the approval of the State Board of Health. But this regulation shall not prevent the corporation from buying from any tenant his crude tallow, or his hides, skins and tripe, at such price as may be agreed upon.

7. The corporation shall at all times keep the basements of the slaughter-houses thoroughly washed and cleaned; and shall provide that no blood, offal or manure shall at any time enter the sewers.

The rendering-house shall be kept in good order, and none of the gases from the rendering-tanks, driers or condensers, shall be permitted to escape into the open air or into the sewers.

Manure from cattle-pens, close-pens and stables, and from the stomachs and intestines of animals slaughtered, must be removed from the premises as often as may be needed to insure cleanliness, and all the grounds of the corporation must be kept in an orderly condition.

8. The corporation shall render the heads and feet of all animals slaughtered on the premises, and shall pay for each set of heads and feet such price as the directors may fix from time to time, subject to the approval of the State Board of Health, unless the parties shall agree upon the price.

9. All blood, intestines, and other offal, the property of the corporation, shall be rendered while fresh, and all scrap and blood shall be dried as soon as may be.

10. The corporation shall furnish the necessary hot and cold water for cleaning the meat and the slaughter-houses; and also water for the stables and stock-yards.

In the use of the machinery and water, the tenant shall exercise all reasonable care to avoid breaking the machinery, wasting the water, and injuring the buildings.

11. All leases shall be executed in the name of the corporation, and shall contain a condition that the lessees shall conform to the foregoing regulations, and to such regulations as shall hereafter be made by the State Board of Health, or by the corporation with the approval of the State Board of Health.

IV.

CHEMICAL ANALYSIS OF PEARL BUTTER.

BY J. M. MERRICK, B. SC.

The sample I procured was yellowish, looking like genuine butter, rather unlike the genuine in texture, being "short" and crumbly, of a pleasant taste, but lacking in the delicate flavor and peculiar taste of real, first-class butter. It is sold as an artificial product, and at a price much below that of genuine butter. I can see nothing objectionable in its use.

The following is the result of my analysis:—

The sample contained—

Fatty matter,	.	.	.	.	.	82.22
Water, .	.	.	.	.	.	12.20
Salt, .	.	.	.	.	.	5.07
Casein, .	.	.	.	.	.	.50
Coloring-matter,	.	.	.	.	.	trifling.
						<hr/> 100.00

I found the melting-point to be 107° 6' Fahrenheit.

Stohmann, the most recent authority, gives the results of a series of analyses of butter, of which I annex three.

QUALITY OF BUTTER.	Fat.	Water.	Salt.	Casein.	Extractive Matter.
Extra fine,	86.95	11.68	1.43	.19	.85
Standard,	85.50	12.29	.93	.57	.59
No. 3,	82.91	14.42	1.78	1.78	1.07*

* The fat of suet, from which artificial butter is made, consists of about forty-six per cent. of stearine (of which nearly four-fifths are removed in the processes of manufacture), the remainder being palmitine and oleine; and that of genuine butter contains (beside about sixty per cent. of palmitine, thirty per cent. of oleine, and a small amount of stearine) four other fats in a proportion of about two per cent., which are peculiar to milk, and give to dairy butter its well-known agreeable flavor; but they are easily resolvable into glycerine and four volatile fatty acids, especially in presence of a nitrogenous substance like casein, which acts as a ferment. It is to the liberation of these volatile acids that the "rancid" smell and taste in common butter become due. Angell and Hehner (London, 1874) place the melting-point of the best butter at 96° 8' F., or slightly below the temperature of the stomach. They think that there are chemical means by which the sophistication of butter with other fats can be detected; but other chemists generally, and especially Wanklyn (London, 1874), are not able to agree with them. The differences in the quantities of salt in the two analyses may be due to peculiarities of taste, one examination having been made in Germany and the other in America. The coloring matter, used also in the dairy for the same purpose, is a harmless vegetable substance from a tropical plant.—[Editor's Note.]

V.

AN ACT TO INCORPORATE THE BUTCHERS SLAUGHTERING AND MELTING ASSOCIATION IN BRIGHTON, AND FOR OTHER PURPOSES.

Be it enacted, etc., as follows:

SECTION 1. Horace W. Baxter, Horace W. Jordan and B. Francis Ricker, their associates and successors, are hereby made a corporation, by the name of the Butchers' Slaughtering and Melting Association, to be located in the town of Brighton, for the purpose of carrying on the business of buying and slaughtering cattle, sheep and other animals, and of melting and "rendering" establishments, subject, however, to the provisions hereinafter contained, and to all general laws now or that may hereafter be in force applicable to such corporations.

SECTION 2. Said corporation may take and hold, by pur-

chase or otherwise, such parcel of land not exceeding one hundred acres in extent, and situated in Brighton, within two miles of the Cattle Fair Hotel, as the state board of health shall by vote determine to be suitable for the carrying on of said business; and said corporation shall within sixty days from the time it shall take any land otherwise than by purchase, file in the office of the registry of deeds for the county wherein said lands lie, a description thereof, as certain as is required in a common conveyance of lands, together with a statement of the purpose for which the lands are taken, which description and statement shall be signed by the president of the corporation.

SECTION 3. The said corporation shall be liable to pay all damages that shall be sustained by any persons in their property by the taking of any land for the purposes of this act. Any person who shall sustain damages as aforesaid, and who shall not agree upon the damages to be paid therefor, may apply by petition for the assessment of his damages, at any time within one year from the taking of said land, to the superior court, in the county in which said land is situate. Such petition may be filed in the clerk's office of said court, in vacation or in term time, and the clerk shall thereupon issue a summons to said corporation, returnable if issued in vacation to the then next term of the said court, held fourteen days at least after the issuing of said summons, and if in term time returnable on such day as the court shall order, to appear and answer to the said petition; the said summons shall be served fourteen days at least before the return day thereof, by leaving a copy thereof with the clerk of said corporation, and upon the return of said summons duly served, the said petition shall stand as a cause in said court, and all questions of fact relating to the damages sustained by the petitioner shall be heard and determined, and the amount of such damages shall be assessed by a jury of said court, unless the parties shall in writing waive their right to a jury-trial and agree that the question of said damages shall be determined by the court; and the verdict of said jury, being accepted and recorded by said court, or the award of the court, if jury-trial shall be waived, shall be final and conclusive, and judgment shall be rendered and execution issued thereon, and

costs shall be recovered by the petitioner if the amount of said judgment shall exceed the amount offered him for his damage by said corporation before the filing of said petition ; otherwise said corporation shall recover its costs.

SECTION 4. Said corporation shall proceed to build upon said land suitable buildings for the slaughtering of cattle, sheep and other animals, and for melting and rendering purposes, and all necessary stables and outbuildings. But no building shall be erected until the plans thereof with all details of construction shall have been submitted to and approved by said state board of health, or some person designated by said board to examine said plans. All the business of said corporation shall be carried on in accordance with such regulations as said board shall from time to time establish and furnish in writing to the clerk of said corporation, and for each violation of any one of said regulations, said corporation shall be liable to a fine of not less than twenty nor more than five hundred dollars, to be recovered by indictment against said corporation. Subject to the foregoing provisions, said corporation may manufacture and sell any of the usual products of said slaughtering and melting business, or may lease or permit other persons to use their buildings or parts thereof on such terms as may be agreed upon. And each member of said corporation shall have the right to slaughter on the said premises, subject to such regulations and such tariff of prices as said corporation may by vote at any regular meeting establish, and to the regulations of the said board of health as aforesaid. And any person engaged in slaughtering or other business on the premises of said corporation who shall violate any of the said regulations of said board shall be liable to the penalty herein before affixed to violation thereof by said corporation.

SECTION 5. The capital stock of said corporation shall consist of two hundred thousand dollars, to be divided into shares of one hundred dollars each, and said corporation shall not take any land, as herein before provided, or commence business, until the sum of one hundred thousand dollars at least shall be paid in cash.

SECTION 6. The state board of health may, if in their judgment the public health shall require, order any person,

at any time engaged in the business of slaughtering within six miles of the Faneuil Hall Market in Boston, and not upon any island in the harbor, to slaughter his cattle, sheep, or other animals, upon the premises of said corporation: *provided*, that thirty days' notice of an intention to pass such an order shall be given to such person by said board, and that after such notice is given such person shall have continued to conduct his business in such a manner as in the judgment of the board is injurious to the public health; and the supreme judicial court, or any justice thereof sitting in equity, shall have power to enforce any such order of said board by injunction. And whenever said board shall make such order as aforesaid, they shall also fix, in said order, the price per head which said party so served with said order shall pay to said corporation for the use of a place in its said building for slaughtering as aforesaid, but said price may be fixed as a certain sum of money, or as a certain portion of the animal, with its blood and offal, and said corporation shall be bound to permit said party to slaughter on its premises, on the terms so fixed by the order of said board, unless said corporation and said party shall agree upon some different terms. Any person aggrieved by any order of the board of health, as in this section provided, shall have the right to appeal from said order in the same manner, and with the same effect, as such right is now given in chapter twenty-six of the General Statutes to a person aggrieved by an order of a town board of health, prohibiting the carrying on of offensive trades. In case of any appeal as herein provided, the application for a jury shall be made to the superior court in the county wherein the party prohibited transacts his business, if in session in said county, or in vacation to any justice of said court.

[*Approved June 16, 1870.*

VI.

AN ACT CONCERNING SWINE-SLAUGHTERING ASSOCIATIONS.

Be it enacted, etc., as follows:

SECTION 1. Three or more persons who shall have associated themselves together by an agreement in writing, such as is

described in section seven of chapter two hundred and twenty-four of the acts of eighteen hundred and seventy, with a capital of not less than one hundred thousand nor more than five hundred thousand dollars, with the intention to constitute a corporation for the purpose of buying and slaughtering swine, and of melting and rendering and pork-packing, shall become a corporation upon complying with the provisions of the eleventh section of said act, with all the powers, rights and privileges, and subject to all the duties, limitations and restrictions conferred by said act upon corporations except as hereinafter provided, and subject to all general laws which now are or hereafter may be in force, applicable to such corporations.

SECTION 2. Such corporation may take and hold by purchase or otherwise such parcel of land, not exceeding one hundred acres in extent, and situated in such place as the state board of health shall by vote approve or determine to be suitable for the carrying on of said business; and such corporation shall within sixty days from the time it takes any land otherwise than by purchase, file in the office of the registry of deeds for the county wherein said lands lie, a description thereof, as certain as is required in a common conveyance of lands, together with a statement of the purpose for which the lands are taken, which description and statement shall be signed by the president of the corporation: *provided, however*, that no land shall be taken under the provisions of this section, without the approval in writing of the mayor and aldermen of the city, or the selectmen of the town in which the land is taken.

SECTION 3. Such corporation shall be liable to pay all damages sustained by any persons in their property by the taking of any land for the purposes of this act. Any person sustaining damages as aforesaid, and not agreeing upon the damages to be paid therefor, may apply, by petition, for the assessment of his damages, at any time within one year from the taking of said land, to the superior court in the county in which said land is situate; such petition may be filed in the clerk's office of said court in vacation or in term time, and the clerk shall thereupon issue a summons to the corporation, returnable, if issued in vacation, to the then next term of the said court, held fourteen days at

least after the issuing of said summons ; and if in term time, returnable on such day as the court shall order, to appear and answer to the said petition ; the said summons shall be served fourteen days at least before the return day thereof, by leaving a copy thereof with the clerk of the corporation, and upon the return of said summons duly served, the said petition shall stand as a cause in said court, and all questions of fact relating to the damages sustained by the petitioner shall be heard and determined, and the amount of such damages shall be assessed by a jury of said court, unless the parties in writing waive their right to a jury trial and agree that the question of said damages shall be determined by the court ; and the verdict of said jury, being accepted and recorded by said court, or the award of the court, if jury trial is waived, shall be final and conclusive, and judgment shall be rendered, and execution issued thereon, and costs shall be recovered by the petitioner if the amount of said judgment exceeds the amount offered him for his damage by the corporation before the filing of said petition ; otherwise the corporation shall receive its costs.

SECTION 4. Such corporation shall proceed to build upon said land suitable buildings for the slaughtering of swine, and for melting and rendering purposes, and all necessary stables and out-buildings. But no buildings shall be erected until the plans thereof, with all details of construction, have been submitted to, and approved by said state board of health, or some person designated by said board to examine said plans. All the business of the corporation shall be carried on in accordance with such regulations as said board shall, from time to time, establish and furnish in writing to the clerk of such corporation, and for each violation of any one of said regulations, the corporation shall be liable to a fine of not less than twenty nor more than five hundred dollars, to be recovered by indictment against said corporation.

Subject to the foregoing provisions, such corporation may manufacture and sell any of the usual products of said slaughtering, and melting and rendering business, or may lease, or permit other persons to use their buildings, or parts thereof, on such terms as may be agreed upon. And each member of

the corporation shall have the right to slaughter on said premises, subject to such regulations and such tariff of prices as the corporation may by vote at any regular meeting, establish, and to the regulations of the said board of health as aforesaid. And any person engaged in slaughtering or other business on the premises of such corporation, who shall violate any of the said regulations of said board, shall be liable to the penalty herein before affixed to violations thereof, by such corporation. [*Approved June 2, 1874.*]

ON THE COMPOSITION OF THE AIR OF THE
GROUND-ATMOSPHERE.

BY WM. RIPLEY NICHOLS,
PROFESSOR OF GENERAL CHEMISTRY IN THE MASSACHUSETTS INSTITUTE OF
TECHNOLOGY.

ON THE COMPOSITION OF THE AIR OF THE GROUND-ATMOSPHERE.

That the atmosphere of invisible gas which surrounds us on every side, and which we call the air, is a ponderable substance; that it exerts a definite pressure upon every surface upon which it rests,—a pressure which may be measured in pounds,—these are facts with which we are familiar from childhood, although we do not ordinarily take cognizance of this substance, except when it is in motion, nor even then, unless it is moving with a velocity greater than one hundred feet per minute.

Less familiar to our minds than the above-mentioned facts, is the consideration that the ground beneath our feet is penetrated to an indefinite depth by the atmosphere; it is a fact which we, of course, know, but which we do not generally recognize.

We observe that water spilled upon the ground soaks into it sooner or later, but when we speak of the porosity of a soil, we are more apt to think of the possibility of filling the pores or interstices of the soil with water than of the fact that, under ordinary circumstances, those pores or interstices are filled with air. In fact, we may determine the relative porosity of different soils by taking vessels of equal size, filling them completely with the soils in question, and then pouring in as much water as the vessel will hold in addition. The water takes the place of air previously confined in the soil, and the volume of air displaced is measured by the volume of water absorbed. Nor is this true simply of sand, gravel and of soils which are recognized as porous; even firm rocks in many cases will absorb a considerable amount of water or, in other words, contain a considerable amount of air. Some varieties of sandstone are thus made up of air to the extent of one-third of their bulk.

If this conception of the presence of air throughout the ground on which we walk is unfamiliar to many, it is far from being generally known that this "ground-atmosphere"* differs in composition from the atmosphere of the air. It is made up of the same gases,—oxygen, nitrogen and carbonic acid,—but the proportion of these gases in the atmosphere beneath our feet is subject to great variation, while in the atmosphere about us it is nearly constant; moreover, the proportion of carbonic acid is considerably greater in the ground-air than in the air of the atmosphere. It is, indeed, only a very short time since investigations into the character of the ground-air were begun, as having possible reference to hygienic questions. Boussingault, to be sure, in 1852, investigated the composition of the atmosphere confined in the upper portion of the ground. His experiments were made, however, on air taken at an average depth of only about fifteen inches, and the matter was considered simply from the stand-point of the agricultural chemist.†

In the year 1854, Pettenkofer,‡ in his investigations on the cholera, called attention to the fact that the air in the ground deserved attention as well as the ground-water. It was not, however, until the year 1870,§ that he began to carry on systematic investigations. These were directed principally to determining the amount of carbonic acid present at various depths. The experiments were conducted in the alluvial gravel of the plain in which Munich is situated, in a locality which had not been subjected to cultivation, and it was found that, as a rule, the amount of carbonic acid was very much greater than in the air of the atmosphere, that the amount of this gas increased with the depth, and that the amount varied with the season, being greatest in summer and least in winter. To illustrate: the largest amount at a depth of 4 meters ($13\frac{1}{2}$ feet) below the surface was 18.38 parts in 1,000

* The term "ground-water" as a translation of the German "Grundwasser" has already obtained a foothold in English; there seems to be no reason why "Grundluft" should not be translated "ground-atmosphere" or "ground-air."

† Boussingault et Léwy. *Memoire sur la composition de l'air confiné dans la terre végétale*. [Annales de chimie et de physique, [3], xxxvii (1853), pp. 5-50.]

‡ Hauptbericht über die Cholera, von 1854, in Bayern, p. 377.

§ Max von Pettenkofer. Ueber den Kohlensäuregehalt der Grundluft im Geröllboden von München in verschiedenen Tiefen und zu verschiedenen Zeiten. [Zeitschrift für Biologie, vii. (1871), p. 395.]

(by volume); this was on August 7. The largest amount at a depth of $1\frac{1}{2}$ meters (5 feet) was 14.15 parts; this was in July 31. The smallest amount at a depth of 4 meters was 3.01, on February 8; at a depth of $1\frac{1}{2}$ meters was 1.58, on February 28.* Since this time frequent determinations have been made in various localities in Munich, under the direction of Pettenkofer, and in Dresden, under the direction of Fleck, and the amount of carbonic acid found has often been much greater than the maximum mentioned above, on one occasion reaching the enormous amount of 80.63 parts in 1,000 (October, 1873).

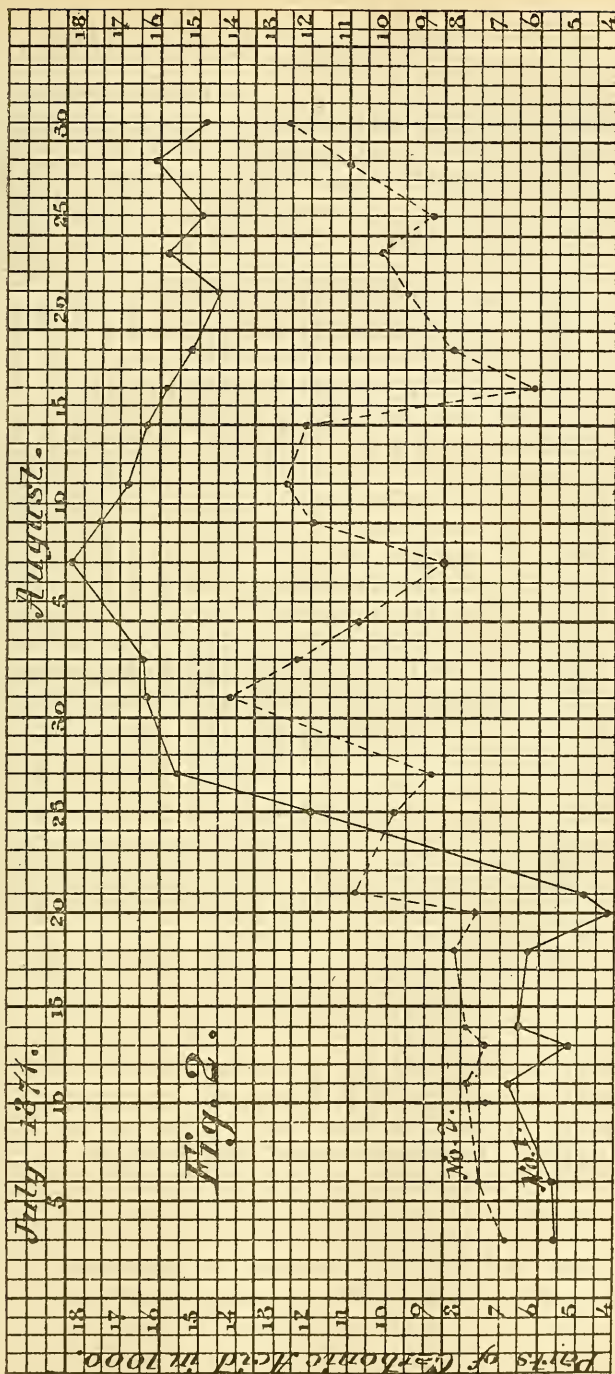
The first experiments made seemed to indicate much greater regularity in the increase or decrease of carbonic acid, according to depth and season, than subsequent investigation has shown generally to obtain. On the following page (Fig. 1) may be found a graphical representation of the amount of carbonic acid at the depth of 4 meters ($13\frac{1}{3}$ feet) and $1\frac{1}{2}$ meters (5 feet), respectively, as found by Pettenkofer in Munich, from September, 1870, to October, 1871.

The curve is a very striking one, with well-marked periods of maximum and minimum; it is, however, constructed from the monthly averages, taking the mean of all the determinations made during each month. I have constructed, on an enlarged scale (Fig. 2), a curve to show the points fixed by all the determinations made during the months of July and August, 1871; and subsequent investigation has shown—as indeed we should not unnaturally expect—that the character and condition of the soil have much to do with the amount of carbonic acid contained in it. This may be very clearly seen by inspecting the following table,† which contains the results of determinations made in different localities during the year 1873, the depth being 4 meters.

* The amount of carbonic acid in the outer air may be taken as generally lying between 0.30 and 0.45 parts in 1,000.

† Jahresbericht der chem. Centralstelle, Dresden, III. (1874), page 13.





Carbonic Acid expressed in Parts per 1,000 (by volume).

MONTHS.						In gravelly soil, on the left bank of the Elbe, Dresden. —Fleek.	In gravel, Munich. —Pettenkofer.	In sandy soil, on the right bank of the Elbe, Dresden. —Fleek.
January,	.	.	.	.	.	46.6	6.8	1.3
February,	.	.	.	.	.	36.6	6.8	2.6
March,	.	.	.	.	.	42.5	5.1	2.2
April,	.	.	.	.	.	39.9	7.7	2.0
May,	.	.	.	.	.	44.8	5.5	2.4
June,	.	.	.	.	.	48.3	6.8	3.8
July,	.	.	.	.	.	42.2	9.5	6.8
August,	.	.	.	.	.	56.6	16.0	4.1
September,	.	.	.	.	.	58.1	17.4	4.2
October,	.	.	.	.	.	60.1	9.3	3.8
November,	.	.	.	.	.	53.5	8.5	2.9
December,	.	.	.	.	.	47.3	10.1	2.2

In this connection, it may not be out of place to introduce some of Boussingault's results, previously referred to; * the depth being, as a rule, about 15 inches.

Carbonic Acid expressed in Parts per 1,000 (by volume).

No.	Description.	Carbonic Acid.
1 and 2, . . .	Land recently manured,	22.1
8,	“ “ “	97.4
3 and 15, . . .	Cultivated field,	9.8
5 and 6, . . .	Vineyard,	9.6
11 and 12, . . .	Forest of Goersdorff,	8.6
16, 29, 31, . . .	Loamy subsoil of same,	8.2
30 and 32, . . .	Sandy subsoil of same,	2.4
18 and 25, . . .	Cultivated field, not recently manured, . . .	7.9
28,	“ “ recently manured,	15.4
13,	Soil rich in humus,	36.4
17,	Cultivated field,	8.7
21,	“ “	8.0
23,	“ “	6.6
22,	Prairie,	17.9

* Annales de Chimie et de Physique [3], xxxvii. (1853), page 49.

The examination into the character of the gases contained in the soil has now been carried on in various localities in Germany for several years. In his first paper on the subject, quoted above, Pettenkofer says: "I present something imperfect and incomplete,—simply investigations on the amount of carbonic acid in the ground-air; it is, however, a beginning which perhaps will influence others to seek further. The whole problem naturally can find its complete solution only when everything which is present in the soil, either in the state of gas or of fine suspended particles, has been accurately investigated and become well understood." In the second paper * he says: "I think that determinations of the amount of carbonic acid in the ground-air might furnish us, in soil of a given character, with a valuable indication of what is designated indefinitely when we speak of the ground's being 'impregnated'; just as in a room full of people we can judge with reference to the overcrowding of the room by the amount of carbonic acid." Of course, it is difficult to generalize and to make deductions from observed facts until a large number of observations have been made; and it is possible that hereafter some better index of *impurity* than carbonic acid may be found; for the present, however, it seems to be the most readily determined of the constituents of the ground-air, and the results obtained are, in many cases, very striking and interesting.

Last spring, I was requested by Dr. Derby, the then Secretary of the Board of Health, to make a contribution to this subject by examining the air below the surface of ground in the "Back-Bay lands" in Boston. This part of the city is *made land*, having been filled in mainly with gravel from the drift deposits in the neighboring country. This gravel was placed directly upon the mud of the Back Bay, and is of varying thickness. Several preliminary experiments were made, and, finally, a connected series of determinations has been carried on in one locality, near the Institute of Technology.

I. The first experiment was made in the vacant lot to the south of the Institute building. The level of the lot is about

* Zeitschrift für Biologie, IX. (1873), page 257.

12 feet above mean low-water, and the sub-soil water rises to within from $3\frac{3}{4}$ feet to $5\frac{1}{2}$ feet of the surface of the ground; the air could not, therefore, be taken at any considerable depth from the surface. An iron pipe, closed and pointed at the lower end, but furnished with a perforation in the side, was driven into the ground, so that the perforation was $3\frac{1}{2}$ feet below the surface. A glass tube was then placed in the iron pipe so that it reached to the bottom, and clean sand was poured into the iron pipe so as to fill completely the space around the glass tube. The top of the iron pipe was then sealed and the glass tube connected with an aspirator. The air was tested for *sulphuretted hydrogen* by drawing ten liters of the air through a solution of acetate of lead. No sulphuretted hydrogen was detected. Another portion of air, amounting to five liters, was drawn through pure water, and the water subsequently tested for *ammonia*. There was found to be 0.00004 gram of ammonia from the five liters of air. This trial was made May 4; subsequently (on May 15) another experiment was made, with identical results. The following are the details of the carbonic acid determinations:

TABLE NO. III.

Air taken three and a half feet below surface.

DATE.	Distance from surface of ground to surface of underground water.	Carbonic Acid, parts in 1,000.
May 4, 1874,	3 feet $10\frac{1}{2}$ inches, .	1.49
" 7, "	3 " $11\frac{1}{2}$ " .	1.53
" 15, "	4 " $0\frac{1}{2}$ " .	1.51
" 18, "	4 " $1\frac{1}{2}$ " .	2.20
" 22, "	4 " 2 " .	2.26

II. A few determinations were also made at another locality on the "Back-Bay lands"; namely, in the rear of No. 523 Columbus Avenue. Here the filling material was very loose sand. The sand was 10 feet in thickness, and the water stood at from 2 to 3 feet from the surface of the ground. A sample of the hard mud was taken up from a depth of 15 feet below the surface, and, after being dried at the temperature of boiling water, was found to lose 8.6 per cent. on ignition.

Although it possessed some disagreeable odor, no sulphuretted hydrogen could be detected when the mud was distilled with water or with acid. The mud contained ammonia compounds and nitrogenous organic matter. Some of the ground-water was also examined, and gave negative results as far as the sulphuretted hydrogen is concerned. A few examinations were made in this locality of air taken at a depth of 2 feet from the surface. No sulphuretted hydrogen was found in $13\frac{1}{2}$ liters of the air on May 19, and on the same date, 5 liters of air were found to contain somewhat less than 0.00002 gram of ammonia, no more than the outer air.

TABLE NO. IV.

Air taken two feet below surface.

DATE.	Distance from surface of ground to surface of ground-water.	Carbonic Acid, parts in 1,000.
May 22, 1874,	2 feet 7 inches, .	—
" 23, "	2 " $9\frac{1}{2}$ " .	1.75
June 17, "	2 " $10\frac{1}{2}$ " .	3.56
" 25, "	—	3.13
July 25, "	3 feet, .	4.77
Sept. 16, "	2 " $2\frac{1}{2}$ inches, .	0.71

III. A somewhat extended series of determinations has been made at another locality, where the depth of gravel is greater; namely, between the Natural History Society's Museum and the building of the Massachusetts Institute of Technology. In this space, the land has been filled in to a level with the street, and the gravel is covered with about a foot of loam; the surface of the lot is about 19 feet above mean low water. This portion of the Back Bay was filled in 1860-61. The distance from the surface of the ground to the beginning of the mud was found to be 19 feet, and a portion of the mud was brought up for examination. It was found (after being dried at 212° F.) to lose 4 per cent. on ignition, and consisted mainly of sand, containing some fragments of shells. It contained traces of ammonia and some nitrogenous organic matter, but no sulphuretted hydrogen or sulphides. Air was drawn through a glass tube from a

depth of 10 feet, and was found to contain some ammonia, but no sulphuretted hydrogen. Two pipes were sunk in the manner described, so as to draw the air from a depth of 6 and 10 feet, respectively; and for the tubes connected with the aspirators, small lead pipes were used. The air was drawn through chloride of calcium to remove moisture, and then through weighed bulbs containing caustic potash solution in which the carbonic acid was absorbed. The amount of air used was 7 liters, except where the quantity of carbonic acid was very small.

The results of the examination are embodied in the table on following page. The analytical determinations recorded here and in the two previous tables, were made by Miss Ellen H. Swallow, A. M., in the laboratory of the Massachusetts Institute of Technology.

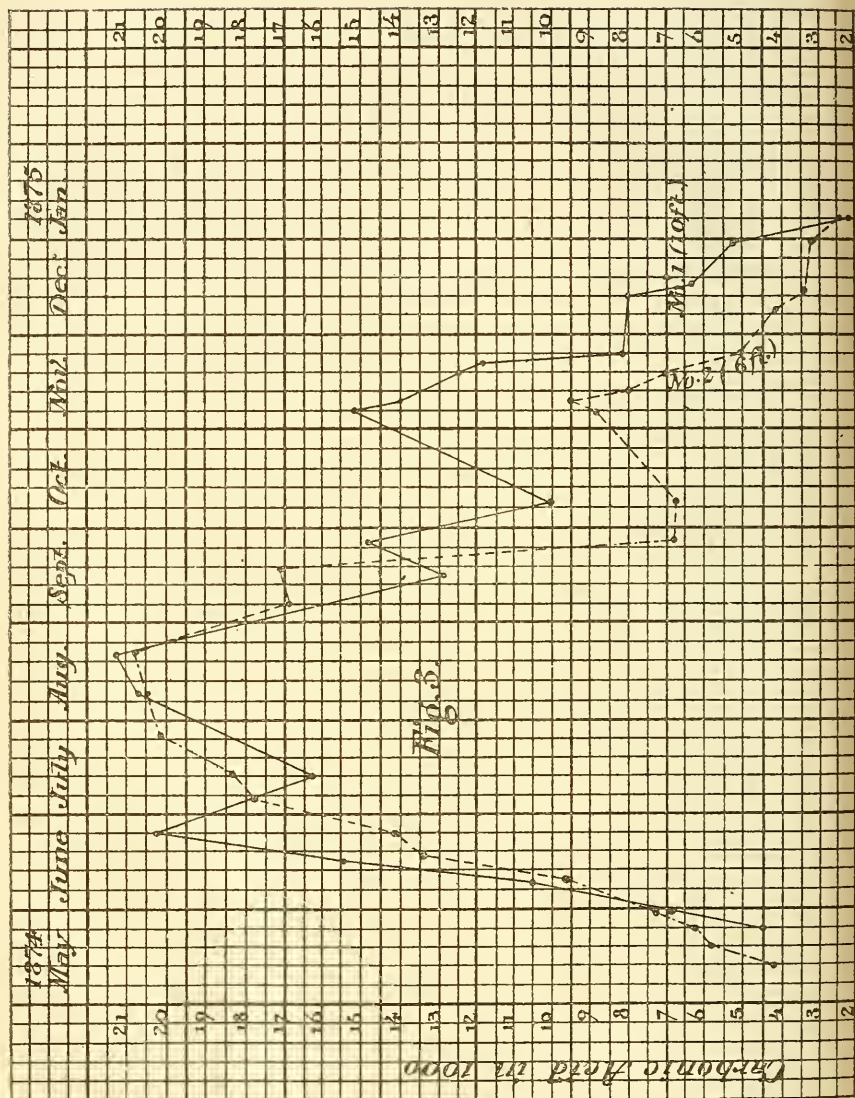
The results expressed in figures in Table V. are expressed as a curve in Fig. 3 (page 218). It appears that there was very little difference in the amount of carbonic acid at the different depths for a considerable portion of the time during which examinations were made; but in October, November and December, the amount of carbonic acid has been sensibly greater at a depth of 10 feet from the surface than at a depth of 6 feet. The results are very similar to those obtained by Pettenkofer in the gravel at Munich.

The question naturally arises, What is the source of this carbonic acid? The carbonic acid in the upper portion of a soil rich in humus is readily explained, it being due to the oxidation of the humus, and as the carbonic acid increases the oxygen decreases, as was shown by Boussingault, who found the sum of the oxygen and carbonic acid to be nearly constant. Moreover, that a large amount of carbonic acid should be found at moderate depths in the soil of the botanical garden at Dresden, which has been highly cultivated, and which is heavily manured twice a year, is not a matter of surprise, but that so much should be found at the station at Munich, which is situated on a mixture of limestone-gravel and sand, and that a not inconsiderable amount should be found in the sand on the right bank of the Elbe, at Dresden, was hardly to be expected, on account of the very small amount of organic matter present. Boussingault examined

TABLE NO. V.

Carbonic Acid expressed in Parts per 1,000.

DATE.	Amount of Carbonic Acid at a depth of		Distance from surface of ground to surface of ground-water.	Remarks.
	10 feet.	6 feet.		
1874.				
May 5,	-	-	10 ft 3 in.	The height of the ground-water was measured at a point some 150 feet distant from the point at which the air was taken. It is, however, sufficiently exact for the present purpose, as there is probably little difference in the height at the two points.
8,	-	-	10 " 6 "	
11,	-	-	10 " 9 "	
12,	-	4.17	} More than 10 ft. 9 in.	
13,	-	4.20		
14,	-	4.01		
16,	-	5.21		
18,	-	5.98		
21,	4.31	6.40	} 10 ft. 8 in.	Air of 10-foot pipe tested for sulphuretted hydrogen with negative results.
22,	4.74	6.33		
27,	6.88	7.24	10 " 8 "	A heavy rain May 25.
June 9,	10.50	9.64	} More than 10 ft. 9 in.	Dry weather. Heavy rain July 12.
17,	15.50	13.40		
25,	20.26	14.20		
July 4,	-	17.59		
13,	16.37	18.37	} 10 ft. 8½ in.	Air of 10-foot pipe tested for sulphuretted hydrogen with negative results.
25,	20.26	20.20		
Aug. 10,	20.60	-		
20,	21.21	20.71	-	Snow and rain the night previous. Very windy. Rain December 7. Rainy. Very cold. Very cold.
Sept. 5,	-	16.97	-	
15,	12.85	17.07	-	
26,	14.73	6.98	-	
Oct. 6,	10.00	6.74	-	A light snow or sleet fell January 2, and covered the surface of the ground with a continuous icy coating which had not melted January 5.
Nov. 5,	-	8.95	-	
6,	15.32	9.52	11 ft. 10 in.	
10,	15.31	9.19	11 " 10 "	
14,	13.13	7.07	12 " 0 "	
18,	12.59	6.88	11 " 11 "	
21,	11.72	5.89	11 " 11 "	
23,	-	4.33	11 " 11 "	
24,	8.08	-	11 " 9 "	
Dec. 8,	8.06	4.11	11 " 10 "	
14,	7.92	3.49	-	
15,	6.39	3.28	11 " 11 "	
29,	5.10	3.23	11 " 11 "	
1875.				
Jan. 5,	2.12	2.45	12 " ½ "	



the air in one or two instances at a depth of a meter and a half (five feet), and inferred that the carbonic acid thus found was formed in the upper portions of the soil by the decay of vegetable matter and carried down by the rain. It is well known that the ground-water contains more carbonic acid and less oxygen than ordinary pond or river water,* and it was not unnatural that the question should arise, whether the carbonic acid at the lower depths might not come from the ground-water. Pettenkofer has, however, disproved this idea, and shown that the carbonic acid of the ground-water is, on the contrary, derived from the ground-atmosphere, or rather that both are to be ascribed to the same source; namely, to organic processes taking place in the ground. In these observations and views he is supported by Fleck, in Dresden, who finds that, as in the soil above, with increase of carbonic acid, there is a corresponding decrease of oxygen, so that these organic processes are processes not of putrefactive decay or of fermentation, but of oxidation. It is to be borne in mind that the atmosphere in the ground is not in a state of rest, but that differences between the temperature of the ground and of the air cause currents of air, and produce effects like those of ventilation; moreover, although carbonic acid is much heavier than air, yet by virtue of the power of diffusion† possessed by all gases, it is passing all the time up through the soil into the outer air, and that if the organic processes concerned in its formation were to cease, the amount in the ground would soon decrease, until the amount in the air about us, and in the atmosphere beneath our feet, would be uniform. We might, at first thought, be inclined to suppose that such a condition of things did obtain in winter, when we see the amount of carbonic acid so much less in winter than in summer, as it was found to be by Pettenkofer in the Munich gravel, and as we have found it in the made land of the Back Bay. It would, no doubt, be true of the upper layer of soil which is reached by the frost, that the organic processes go on with extreme slowness, if at all, in winter, but in the lower strata the temperature is subject to

* See, for instance, the Fifth Annual Report of the Massachusetts State Board of Health, page 138 (*compare* Nos. 207 and 205).

† See Appendix B (page 224) for an illustration of this power of diffusion.

much less variation, and never falls much lower than 40° F. The variations, then, in any locality seem to depend, in very considerable measure, on varying facility for diffusion, and the diffusion seems to be greater when the temperature of the atmosphere falls below that of the ground.

It is to be borne in mind that the amount of carbonic acid found at any time, is the difference between the amount actually produced and the amount carried off by diffusion and by the ground-water. The amount, then, that is found in different soils, and under differing conditions, cannot be taken as a measure of the intensity of the processes concerned in its production, for very much depends on the character of the soil, especially in the matter of porosity. At present it does not seem to be possible to draw much useful information from the determination of the carbonic acid in the ground-air. As the number of the determinations increase, and the laws of the variation are better understood, it is possible that, like the height of the ground-water, it may be found to connect itself with causes and effects of sanitary importance.

With reference to the examinations made of the ground-air in the "Back-Bay lands," it may be a matter of surprise to some that the air was not found worse; certainly the popular mind is apt to consider the layer of mud as a fruitful source of sulphuretted hydrogen and other foul and offensive gases. It is possible that some localities might be found where the condition of things is worse than in the places examined; but wherever the mud is properly covered, it is not probable that any offensive gases *can pass through the gravel*, and where the mud is covered constantly with water, the decomposition of the organic matter takes place with extreme slowness. It is possible that some of the carbonic acid found in the gravel on the Back Bay may have come from the slowly proceeding decomposition of the mud underneath.

Some interesting experiments have recently been performed by Professor Fleck, in Dresden, on the influence of decomposing matter on the air of the adjacent soil; an abstract of his results is appended to this paper.

The rapidity with which even a heavy gas like carbonic acid *diffuses* is so apt to fail of being recognized, that it may not be felt useless to append also an abstract of some experiments of Pëttenkofer on this subject.

APPENDIX A.

THE AIR IN THE SOIL ABOVE DECOMPOSING BODIES.

In his researches on the effects of the cemeteries on the well-waters of Dresden, Professor Fleck made some interesting experiments on the effect of decomposing dead bodies on the air of the ground in their neighborhood.

A pit was dug two meters ($6\frac{2}{3}$ feet) deep, and in it were placed, side by side, in a vertical position, four earthen tubes, two meters long and 0.25 meter (10 inches) wide, and the earth was filled in again about them. The tubes were partially filled with different materials corresponding to different varieties of soil; a dead rabbit, weighing in each case about five pounds, was then put in, and the remainder of the tube filled with the same materials.

Two rabbits were thus buried in clay (Nos. I. and II.), one in fine sand (No. III.), and one in clean gravel which had been screened to a uniform size (No. IV.). Arrangements were made, so that by means of small lead pipes air could be drawn from these artificial graves immediately above the dead body and also at a distance of 1.1 meters (43 inches) above the body; that is, about twenty inches below the surface of the ground. Two of the graves were arranged so that the rain-water and the melted snow passing through the soil and over the body could be collected beneath in iron pots, and be withdrawn for examination by means of small tubes.

In filling these experimental graves, the conditions were made to resemble as nearly as possible those which obtain in actual graves, and as the soil (especially in the case of the clay) sank together, more was thrown in on top.

The experiments were begun October 7, 1873, at which date the amount of carbonic acid in the ground-air was determined, and after an interval of two weeks regular determinations were made.

The results obtained were as follows :—

TABLE No. VI.

Carbonic Acid expressed in Parts per 1,000.

DATE.	No. I (CLAY).		No. II (CLAY).		No. III (SAND).		No. IV (GRAVEL).	
	a—Above the body.	b—20 inches from surface.	a—Above the body.	b—20 inches from surface.	a—Above the body.	b—20 inches from surface.	a—Above the body.	b—20 inches from surface.
1873.								
Oct. 7,	3.07	2.23	8.54	1.00	3.38	0.90	10.46	1.00
21,	50.57	38.08	83.09	19.45	50.61	12.13	37.12	4.15
28,	82.91	36.26	53.27	20.61	43.59	6.85	34.90	3.35
Nov. 5,	84.40	43.13	62.90	13.85	37.33	5.39	42.88	5.33
12,	80.13	35.23	57.78	9.29	27.85	1.78	19.11	3.50
18,	144.00	37.40	105.10	27.80	52.80	4.80	55.70	9.60
25,	127.70	23.00	101.80	10.60	25.90	3.40	30.70	5.30
Dec. 2,	121.00	43.20	99.80	4.80	60.30	9.60	36.50	5.80
10,	119.00	44.20	89.30	2.40	49.90	5.30	21.10	3.20
16,	109.40	47.00	94.00	4.80	49.90	—	36.00	—
23,	121.90	49.90	100.80	6.20	28.80	3.80	32.60	—
30,	140.20	57.60	103.70	8.60	14.40	1.00	26.90	1.00
1874.								
Jan. 7,	75.13	36.96	56.03	12.19	23.86	4.82	9.19	6.40
Feb. 3,	—	6.83	—	4.40	18.79	3.54	13.44	10.62
10,	—	5.24	—	1.81	32.38	7.20	18.57	5.63
17,	—	4.98	—	2.13	32.36	0.71	3.25	0.52
24,	—	7.26	—	4.37	49.09	9.62	11.78	2.32

During a certain length of time, determinations of oxygen as well as of carbonic acid were made, and the amount found showed, beyond question, that as long as there was opportunity for the diffusion of atmospheric air into the graves, the decomposition of the organic matter is mainly a process of oxidation.

The table given above shows a very different state of things in the different graves, and, shows too, how great an influence the character of the soil has upon the composition of the ground-air. It is, moreover, well known that dead bodies require about twice as long a time in clay as in sand for their complete decomposition. Hence it is evident that the amount of carbonic acid cannot be taken as a measure of the intensity of the processes of decay which are going on in soil.

The blanks in columns one and three of the table are owing to the fact that after February 3, the clay had become so compacted that the bodies which were buried in the clay were hermetically sealed, so that the air of the atmosphere had no access to them.

With regard to gases other than carbonic acid arising from the decay of the organic material, the amount was found to be very small. Traces only of sulphuretted hydrogen were found, and the amount of ammonia was very trifling, never more than 0.0026 part by volume in 1,000 parts of the air. After removal of the carbonic acid and ammonia, the gas still possessed a peculiar odor, pointing to the presence of other gaseous compounds which are now in process of investigation.

The rain-water which filtered through the ground and passed over the dead bodies was collected beneath them and examined. This water was found to contain a large amount of nitrogen, chiefly in the form of the compound ammonias (amines); the water also contained lactic acid and some of the lower members of the fat-acid series.

Arrangements had been made so that portions of the decomposing bodies could be withdrawn from time to time. The bodies were found to possess a herring-like odor and to be covered with a soapy coating consisting in the main of protein substances in the process of decomposition, and containing compound ammonias and fat acids (or rather the salts formed by their combination). Simply pouring caustic potash on the mass sufficed to show the presence of trimethyl-amin, and other tests showed the presence of some mon-amin; and as solutions containing these bodies pass into the ground-water, the effect thus produced is likely to be of more importance than any gaseous emanations from the ground. [*Jahresbericht der chemischen Centralstelle für öffentliche Gesundheitspflege in Dresden*, III. 1874, pp. 37-44.]

APPENDIX B.

RAPID DIFFUSION OF CARBONIC ACID.

In a paper published in the "Zeitschrift für Biologie," for 1873, Pettenkofer alludes to a popular idea which, in spite of theoretical and direct evidence to the contrary, still has currency; namely, that in a badly-ventilated room the worst air collects at the bottom, on account of the high specific gravity of carbonic acid. He then gives the details of some experiments which illustrate in a remarkable manner the very great rapidity with which a heavy gas diffuses into another gas with which it is in contact, even when the heavier gas is situated below the lighter.

These experiments were performed at a mineral spring at Marienbad, where there is a constant evolution of carbonic acid from the surface of the basin in which the water is confined. This basin is quite large, and is used for bathing; it is covered by a light wooden building, and the evolution of carbonic acid is very considerable. It is estimated that, if no diffusion took place, at the end of an hour the building would contain over the surface of the water a layer of carbonic acid 12 feet in thickness.

Pettenkofer found the gas escaping from the water contained 70 per cent. of carbonic acid; the air 3 inches above the surface contained 31 per cent. of carbonic acid; the air 10 inches above the surface contained 23 per cent. of carbonic acid; the air 40 inches above the surface contained 2 per cent. of carbonic acid; the air 55 inches above the surface contained less than $\frac{1}{2}$ per cent. of carbonic acid.

As the carbonic acid is evolved continually, we see how rapidly it diffuses into the atmosphere, or how rapidly the gases of the air diffuse into the carbonic acid layer, so that, at a height of 40 inches above the surface of the water, the carbonic acid amounts to only about 2 per cent. of the volume of the air, and this, too, in a space inclosed by a structure built of boards, and not freely open to the air.

VENTILATION OF RAILROAD CARS.

By THEO. W. FISHER, M. D.

(OF BOSTON.)

WITH CHEMICAL ANALYSES,

By WM. RIPLEY NICHOLS,

PROFESSOR OF GENERAL CHEMISTRY IN THE MASSACHUSETTS INSTITUTE
OF TECHNOLOGY.

VENTILATION OF RAILROAD CARS.

The object of this paper is briefly to call public attention to the insanitary condition of the passenger-cars on our railroads, and to introduce some tests and experiments on the air in smoking and other cars made by Prof. W. R. Nichols, of the Massachusetts Institute of Technology, at the request of the State Board of Health.

This subject of car-ventilation may seem trivial when we consider the brief period of occupancy in individual cases, but even in this point of view, it is of some importance; and to that quite large class of persons who spend several hours daily in the cars, it is of the most vital interest. The American people are eminently a travelling public, and the aggregate of time spent in this way is worth considering. Massachusetts, according to the Railroad Commissioners' Report for 1873, has 1,735 miles of railroad, or about one mile to every 879 inhabitants, and to every four square miles of territory. The number of passengers carried annually is over forty-two millions. These facts show the importance of making all public conveyances equal, at least, in their hygienic condition, to our school-houses and other public buildings.

That this is not the case, the travelling public has daily sensible demonstration. Universally defective methods of heating and ventilation of steam-cars lead to bad air, oppressed breathing, hot, heavy and aching heads, cold feet, coughs and debility, to say nothing of the discomforts of heat, dust and bad odors in summer. To these are added the deleterious effects of the concentrated fumes of tobacco, when the traveller is driven for a seat to the smoking-car.

A striking illustration of how bad the condition of things

may become, is found in a monograph, by the Baron N. de Derschau, a Russian engineer, upon Heating and Ventilation of Railway Cars (Paris, 1871). An experiment was made on an American car, running as third-class between St. Petersburg and Moscow, during the winter of 1866. The car was 50 feet long, and carried 80 passengers. The outside temperature at starting was 22° F. below zero, the inside 16° below, and there was no means of heating. Observations were made hourly, with the following result: The temperature rose from the accumulation of animal heat until, at the end of nine hours, it was, in the upper part of the car, 21° above zero, while on the floor it was still 6° below. The carbonic acid increased to alarming proportions; viz., from .140 per cent. at starting to .940 per cent. the last hour! The hygrometer, as well as the frost on the windows and the fog in the air, showed that the saturation point for moisture had been reached. The experimenter left the car at the ninth hour physically unable to continue his tests.

This was, of course, an extreme example of what exists in a less degree in every ill-ventilated car. In cold and rainy, or in hot and dusty weather, the opening of windows is impracticable, and passengers suffer the insidious effects of bad air in avoiding the more obvious dangers from dust and draughts. The opening of doors at stations affords but little relief, since the cars are not then in motion so as to create a thorough draught.

The smoking-car is a purely American institution. In England and France, smoking is forbidden in the first and second class carriages, but is connived at by the guards, on the payment of a small fee, if no one in the compartment objects. In Germany, smoking is so universal that a contrary custom prevails, and smoking is allowed everywhere, except in certain compartments marked "*Für nicht Raucher*" (no smoking), where tourists and ladies may avoid the fumes of pipe and cigar, if they wish. Our custom is to collect all smokers into one car, thus concentrating the products of burning tobacco, which might otherwise be diffused through the whole train.

The bad hygienic condition of these moving fumatories must be more or less familiar to all. The fact that the air is

irrespirable by most non-smokers, including the whole female sex, is sufficient to show this without the aid of chemical tests, which often fail to detect subtle atmospheric qualities, which may be evident to the senses, and fruitful sources of disease and death. Exceptional mischief of a serious kind has recently served to direct attention to the above fact; a young man having been killed by falling from the platform of a moving train, in consequence, it was supposed, of the dizziness produced by a brief stay in the smoking-car.

The following experiments of Prof. Nichols will furnish approximate evidence of the purity of the air in cars, under various circumstances, by showing the amount of carbonic acid present. This gas is irrespirable, except in the smallest quantities, and is generally accepted as a fair standard of the amount of other impurities given off by the skin and lungs, which tend by their immediate putrefaction to produce directly poisonous effects upon the human system.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, }
Boston, December 12, 1874. }

DEAR SIR:—Having been requested by Dr. Folsom, Secretary of the State Board of Health, to make some investigations into the character of the air in smoking-cars, I beg leave to report herewith the results of such determinations as have been made.

Every one recognizes the “closeness” of the air on entering, at this season of the year, an ordinary passenger-car which is moderately full. We are not able to determine exactly the substances in the air which cause this feeling and which produce the injurious effects experienced by remaining for a considerable length of time in ill-ventilated or overcrowded apartments. As, however, the exhalations and emanations causing the injurious effects are always composed in part of, or attended by, *carbonic acid*, and as the amount of this compound can be estimated with great exactness, it is usual to take the carbonic acid as affording an indication of the completeness or deficiency of the ventilation.

In the case of smoking-cars, in addition to the exhalations and emanations from the passengers, the products of the tobacco consumed mix with the air and render it oppressive

to most non-smokers. The products of the combustion of tobacco, if the combustion were complete, would be carbonic acid, ammonia and water; in the process of smoking, however, most of the tobacco is distilled rather than burned, and the products of this distillation are quite numerous and complex. The most complete investigation into the composition of tobacco-smoke with which I am acquainted, was made by Vohl and Eulenburg.* They smoked artificially a considerable quantity of tobacco and claim to have recognized with distinctness in the smoke, cyanhydric acid, sulphuretted hydrogen; certain acids of the fatty acid series,—namely, formic, acetic, propionic, butyric and valerianic; also, carbolic acid and creasote; also, pyridin, picolin, collidin and other similar alkaloids, but no nicotin. They found also, in the smoke, ammonia, nitrogen and oxygen, and small quantities of marsh-gas and carbonic oxide.

I have made several attempts to obtain evidence, by chemical means, of the presence in the air of smoking-cars of some of the characteristic products of the smoking of tobacco, but without success. On one occasion I rode from Worcester to Boston, drawing a portion of the air of the car through proper absorbing media. The train was express, and the car was completely filled, and the smokers were about in the usual proportion,—perhaps one-half of the passengers were smoking. Of the peculiar components of the tobacco-smoke, it seemed to me that the fatty acids, so called, butyric, valerianic and acetic acids, would be bodies to be tested for with the greatest hope of success, but I tested also for the alkaloid bodies, which probably form the most injurious portions of the smoke. On this occasion 10 liters ($2\frac{1}{5}$ gallons) of air were drawn through the absorbing liquid, but the results were negative. On another occasion 30 liters of air were employed, and on several other occasions quantities lying between these two; in no case was I successful in separating and identifying any of these peculiar products. This, however, is not a matter of great surprise. Vohl and Eulenburg, in the experiments mentioned above, appear to have determined the character of the acid products by consuming 50 cigars, and the alkaline products by the consumption of 100

* Archiv der Pharmacie, [2] 147 (1871,) p. 130.

more. The statement is not, however, quite clear,* and the *amount* of any substance obtained is not given. The whole of the products of the distillation (except the permanent gases) were condensed by them or absorbed in appropriate liquids; in the actual process of smoking, a considerable quantity of these substances are absorbed by the smoker, and what does escape into the air is so diffused, even in a poorly ventilated car, that it would be necessary to use a very large amount of air in order to discover the peculiar bodies of tobacco-smoke, and even then the amount, except by the use of cars-full of air, would be too small to estimate quantitatively. A very little tobacco-smoke does indeed affect the eyes and throat of a person unaccustomed to its use, but our senses are often affected by quantities too small to weigh, too small even to detect by chemical means.

The question, then, from a chemical point of view, seemed to resolve itself into a question of ventilation, and a number of experiments were made to determine the amount of carbonic acid in the air of the cars. The results of these experiments are embodied in the following table.

The following experiments were made to see whether there was an increase of carbonic acid during the trip:—

* The process of separating the alkaloids required several fractional distillations and recrystallizations of the platinum compounds into which they were converted. The authors detail the separation, the identification by physical properties, the determination of the boiling-point, the elementary analysis, and the analysis of the platinum compounds in each case. It seems hardly possible that so small an amount of tobacco as indicated above, could have furnished the material for reliable determinations, and it is possible that some error may have crept into the statement of the amount.

TABLE NO. 1.—*Smoking-Cars.*

No.	Date.	Carbonic Acid in volumes, per cent.	RAILROAD.	Description of Train.	Sample taken between—
1	Nov. 4, .	0.233	Providence, .	} Dedham train reaching Boston at 7.35 A. M., . {	Roxbury and Boston.
2	4, .	0.261	" .		" "
3	4, .	0.173	" .	} Same train as Nos. 1 and 2; different car, not so full, . {	" "
4	7, .	0.335	" .		" "
5	13, .	0.283	" .	} Dedham train reaching Boston at 7.18 A. M., . {	" "
6	23, .	0.253	" .		" "
7	24, .	0.171	" .	} Stoughton train reaching Boston at 8.10 A. M., . {	" "
8	27, .	0.242	Fitchburg, .		Boston and Cambridge.
9	27, .	0.140	" .	} Watertown Branch train leaving Boston at 5.55 P. M., . {	Cambridge and Mt. Auburn.
10	Dec. 3, .	0.369	Providence, .		Boylston and Boston.
11	3, .	0.317	" .	} Dedham train, due in Boston at 7.35 A. M., . {	" "
12	4, .	0.098	Eastern, .		Boston and Lynn.
13	4, .	0.127	" .	} Stoughton train, due in Boston at 8.10 A. M., . {	Lynn and Boston.
14	9, .	0.234	Fitchburg, .		Boston and Cambridge.
15	9, .	0.179	" .	} Same train as Nos. 8 and 9, . . . {	Cambridge and Mt. Auburn.

NOTE.—The method employed for estimating the carbonic acid, was that known as Pettenkofer's, and the air was taken at the height of the heads of the seated passengers.

The following determinations were made in ordinary passenger-cars:—

TABLE No. 2.—*Passenger-Cars.*

No.	Date.	Carbonic Acid in volumes, per cent.	R A I L R O A D.	Description of Train.	Samples taken between—
16	Nov. 13,	0.367	Providence, .	} Stoughton train reaching Boston at 8.10 A. M., . {	Jamaica Plain and Boston.
17	24,	0.298	" .		" "
18	Dec. 3,	0.174 .	" .	Dedham train reaching Boston at 7.18 A. M., .	Boylston and Boston.
19	3,	0.174 .	" .	Stoughton train reaching Boston at 8.10 A. M., .	" "
20	8,	0.159	" .	} Dedham train reaching Boston at 7.35 A. M., samples { taken in different cars,	" "
21	8,	0.219	" .		" "

NOTE.—The trains mentioned in Tables No. 1 and No. 2, were all local, and the greatest distance passed over, before the sample was taken, was about fourteen miles.

The air in the smoking-car of the Stonington steamboat train, on the Boston and Providence Railroad, was examined at intervals during the journey from Boston to Providence, Friday, December 11, 1874. The train left Boston at 5.30 P.M., reaching Providence at 7.05 P.M. The capacity of the car was about 2,750 cubic feet net. The number of passengers was thirty-seven, of whom eighteen were smoking. This was about the average during the trip.

No.	Carbonic Acid volume, per cent.	TIME.	Length of Time.	After leaving—
1	0.172	5.35 P.M.,	5 minutes,	Boston.
2	0.158	5.50 "	20 "	Boston.
3	0.153	6.05 "	35 "	Boston.
	—	6.10 "	*	—
4	0.194	6.15 "	5 "	Sharon.
	—	6.22 "	†	—
5	0.165	6.35 "	12 "	Mansfield.
	—	6.38 "	‡	—
6	0.177	6.45 "	7 "	Attleborough.

* Train stopped at Sharon.

† Train stopped at Mansfield.

‡ Train stopped at Attleborough.

A somewhat similar experiment (but less extended) was made December 9, 1874, on the Watertown branch of the Fitchburg Railroad. The capacity of the car (after deducting the space actually occupied by the passengers) was about 2,350 cubic feet.

No.	Carbonic Acid volume, per cent.	Number of Passengers.	Number Smoking.	TIME.	Train—
	—	—	—	5.55 P.M.	Left Boston.
	—	—	—	5.58 "	Left Charlestown.
1	0.234	44	15	6.05 "	— —
	—	—	—	6.07 "	Stopped at Cambridge.
2	0.179	34	8	6.10 "	— —
	—	—	—	6.13 "	Stopped at Mt. Auburn.

On several occasions, I made comparative tests for the *ammonia* present in smoking-cars and passenger-cars. The amounts in the following table are *comparative*, simply.

1.		Outer air, Back Bay, average,	100
2.	Nov. 13.	Providence Railroad smoking-car,	575
3.	Dec. 4.	Eastern Railroad smoking-car,	310
4.	" 4.	" " " " after stopping at a station,	266
5.	" 11.	Providence Railroad steamboat train, taken at same time as carbonic acid (No. 3) of same date,	400
6.	" 11.	Ditto. Taken at same time as carbonic acid (No. 6) of same date,	340
7.	" 8.	Providence Railroad, common car,	135
8.	" 8.	" " another "	175

I may remark, that more of the samples have been taken on the Providence Railroad than on any other, simply because it was more convenient of access.

Yours very respectfully,

WM. RIPLEY NICHOLS.

Dr. T. W. FISHER.

The first fact noticeable in Prof. Nichols' report is, that the amount of carbonic acid found in cars exceeds considerably the average for public buildings, and is, of course, largely in excess of what would be found in the dwellings of the better classes, or in the open air. In the Report of the State Board of Health, for 1871, an article, by the late Dr. Derby, on "Air, and some of its Impurities," gives the average per cent. for the outer air in this vicinity as .035, and for school-houses as about .140. The Music Hall is set down at .140 after a concert; Municipal Court-room, .120; Globe Theatre, .144; Waiting-room of Public Library, from .136 to .193, etc.

The average of Table No. 1 gives the percentage for smoking-cars at .228, the lowest example being .127, and the highest .369. The average of Table No. 2 gives for passenger-cars a percentage of .232; lowest, .174; highest, .367. The air on the Stonington steamboat-train smoking-car was exceptionally pure, the average being .170. The car was by no means full, and but half were smoking. The smoking-

cars of the New York express trains, on the Boston & Albany Railroad, would, perhaps, furnish more marked results. These cars will accommodate 70 passengers, and, according to Mr. F. D. Adams, of that road, are usually filled with smokers, who play euchre from Boston to New York, in an atmosphere of dense smoke. The ordinary ventilators are of no use in clearing the car, and wickets in the ends are required to make any impression on it.

The tables show also a second fact; viz., that the additional amount of carbonic acid produced by the combustion of a few ounces of tobacco is hardly appreciable. Prof. Nichols estimates that if all the carbon of the tobacco were completely burned to carbonic acid, the carbonic acid formed might amount in weight, at a maximum, to one-quarter more than the amount of tobacco consumed. In actual practice, however, much of the carbon is not burned to carbonic acid, but some is given off in the state of carbonic oxide, and more, probably, in the form of compounds of carbon and hydrogen in matters of the nature of tar. The carbonic acid from this source would not indicate, however, any additional impurities from the lungs and skin, and it may be disregarded. A newspaper paragraph is authority for the statement, that Dr. Otto Krause, of Annaberg, Saxony, has found nine per cent. of carbonic oxide in tobacco-smoke; but this seems a large amount.

Let us examine, then, this question of ventilation in another way. The average capacity of a passenger-car is about 2,500 cubic feet of net air-space, excluding that occupied by passengers and furniture. A smoking-car, as arranged with tables, chairs and sofas will accommodate at least 50, and an ordinary car 75 passengers. This gives, in the first case 50, and in the last $33\frac{1}{3}$ cubic feet of air-space to each passenger. The amount of air-space and of air per hour to insure proper ventilation has been variously estimated. Army regulations for hospitals and barracks require from 1,000 to 1,500 cubic feet of air, changed hourly, per soldier. The British Royal Commissioners, appointed in 1857, recommend 600 cubic feet of air-space, and 20 feet of air per minute and per man. Ten feet per minute is the lowest estimate suggested in any case. Take 15 feet per

minute, then, as an average, and the air in smoking-cars should be changed thoroughly at least every four minutes, and in ordinary cars every three minutes, to insure proper ventilation. It is evident this is never accomplished.

It may be useful to insert here a table from a standard French work, by Gen. Morin, on "Heating and Ventilation" (Paris, 1874). I have reduced the metres to feet for convenience' sake.

Volume of air necessary to introduce and withdraw hourly for each person, to insure good ventilation.

		Cubic feet.
Hospitals, .	{ Ordinary sickness,	2,100-2,450
	{ Surgical and lying-in,	3,500
	{ Epidemic,	5,250
Prisons, . . . . .	. . . . .	1,750
Workshops, .	{ Ordinary,	2,100
	{ Unhealthy,	3,500
Barracks,	{ By day,	1,050
	{ By night,	1,750
Theatres, . . . . .	. . . . .	1,400
Public halls, . . . . .	. . . . .	2,100
Lecture rooms, . . . . .	. . . . .	1,050
Schools,	{ Infant,	420-525
	{ Adult,	875-1,050
Stables, . . . . .	. . . . .	6,300

These figures, Gen. Morin states, are based on direct observation, and are not in the least exaggerated. The point at which all sensible odor from effete animal matter disappears is taken as the limit of satisfactory ventilation. This limit is not usually reached while more than .06 per cent. of carbonic acid remains.

Dr. R. Angus Smith says, in his "Air and Rain," a work of undoubted authority: "We cannot accept a lower standard of carbonic acid than .06 per cent.; and uniform diffusion being supposed, we cannot preserve our minimum standard of purity with a less delivery of fresh air than 3,000 cubic feet per head per hour!" This limit is also recommended by Pettenkofer. It will be seen how wide of any such standard is the condition of our steam-cars when each passenger has only from $33\frac{1}{2}$ to 50 feet of air-space; and air so seldom changed as to leave a percentage of from 0.2 to 0.3 volumes of carbonic acid!

The heating and ventilation of cars seem to be inseparable subjects. The monogram of the Baron de Dershau treats

of the former in quite a thorough manner. He mentions only to condemn the various methods in use, such as foot-warmers of hot water or hot tiles, hot-water pipes, stoves of porcelain and iron, and iron stoves outside the cars, over which air is conducted to the interior. He concludes that steam alone is adapted to the purpose; and it is impossible not to agree with him, when we think of the dangerous and unmanageable fire-boxes so universally in use with us. Our stoves, besides overheating the air when approaching a red-heat, as is often the case, are subject to as great extremes of temperature as a bad case of chills and fever. The heat is also badly diffused in the car, and is of little or no aid to ventilation.

Steam-heating is in use on some American railroads, as well as in Russia, Belgium, Germany and Austria. The Baron de Dershau gives a complete description, with plans and specifications, of a system which he has introduced with success in Russia and elsewhere. It consists, briefly, of a special boiler for every eight cars, placed in a small compartment at the end of one of them, and tended from the platform. The steam is conveyed along the roofs in pipes encased in felt, and fed by vertical pipes into heating-tubes along the sides of the car-floor, the water of condensation being returned to the boiler by a pipe beneath the cars.

This system seems to have had no special relation to the ventilation of the compartments to which it was applied. This was provided for by an opening in the roof, allowing for a temperate climate 22 and for a cold climate 28 square centimeters of area for each passenger. Air was admitted by ventilators under the eaves, with openings arranged to catch the draught of the moving train. In a car fitted up for the emperor's summer use, air was admitted through wire screens in the floor, and carried up through hollow pillars containing a cooling mixture, being discharged through small ornamental openings in the capitals into the car.

Most American cars are now made with the Wagner monitor-roof, with patent pipes and apertures for the exit of foul and heated air, in great number and variety. These are not efficient, however, without provision for the admission of fresh supplies of air from below. Side and end ventilators

have therefore been devised for this purpose, but are all open to certain objections. Those in the letter-line over the windows are too high up, and, as well as the wicket-sashes in the doors and end-windows, expose passengers to severe draughts, and, consequently, are seldom allowed to be open.

The eighth annual report of the Master Car-builders' Association, in convention at Cincinnati in June of last year, contains the report of a committee on heating and ventilation of much interest. The discussion on this report clearly shows the difficulties of the subject, and the various opinions and experiences of the representatives of different railroads, as well as a disposition to do something to improve the construction of cars, with respect to their sanitary arrangements. The report admits fully the importance of ventilation, and quotes at length Dr. Smith's experiments upon himself in the lead-chamber. It admits that a car has hardly sufficient air-space for *four*, instead of seventy-five persons; and that the solid and liquid impurities given off by a car-full of passengers, amounting, according to Prof. Huxley's estimate, to two pounds every twenty minutes, will no more go out of roof-ventilators without forcing, than fire-damp out of a mine.

The top and letter-line ventilators have proved entirely inadequate to effect the requisite change of air. The arrangements for admitting air at the end of the car, depending on the motion of the train, are most efficient, but most objectionable on account of the draught. To admit 2,400 feet per minute, at as slow a rate as five feet per second, there must be an opening as large as the whole end of the car; to make a greater velocity endurable, the air must be distributed through the car before reaching the passengers.

The system of Messrs. Sanborn & Gates, 15 West Street, Boston, was mentioned very favorably by the committee. This consists in a fan-wheel, carried by a pulley attached to one of the axles, which forces air into the car, through a strainer of wire-gauze, at the first side window. The air is conducted around the roof in a 6-inch pipe, perforated at proper intervals, and finds its exit through registers in the floor. This apparatus has been applied to a car on the Boston & Albany Railroad, and was tested by a company of gentlemen well known to the public, in May last. The report of a committee

of observation will be found in the "Boston Post," May 6, 1874. When the car had been thoroughly filled with smoke, on admitting the air it was entirely cleared in about six minutes. It is intended to regulate the temperature and moisture by means of a heater and evaporator.

Mr. Adams, of the Boston & Albany Railroad, says the above apparatus works well, except on up-grades, where speed is too low for the best effect. It seems evident that some combination of steam-heating and forced ventilation must some time be found to solve the problem under consideration, unless railroad companies continue to be deterred by the expense incidental to its introduction. It was not intended to go into a critical examination of methods here. Such practical questions are for car-builders and railroad corporations to consider. The public should see that the efforts of these parties are not suspended through motives of false economy, or a lack of appreciation of the importance of perfect ventilation for all passenger-cars, both summer and winter, and in all weathers.

CREMATION AND BURIAL:
AN EXAMINATION OF THEIR RELATIVE
ADVANTAGES.

By J. F. A. ADAMS, M. D.
(OF PITTSFIELD.)

CREMATION AND BURIAL.

One of the most striking results of the Vienna Exposition of 1873, was the diffusion throughout the civilized world of an interest in the subject of cremation, and in the substitution of this ancient method of disposing of the dead for burial, which has been the universal custom of all Christian peoples. At this Exposition, Prof. Brunetti, of Padua, exhibited in a glass box three pounds and three-quarters of delicate white ashes, obtained by the incineration of a human body. The box bore this inscription: "*Vermibus erepti, puro consumimur igni.*" These ashes were the first practical result of a study which had occupied many active minds in Italy since 1869; and all who saw them involuntarily fell to thinking whether such a change, through the purifying agency of fire, were not a more fitting destiny for the cast-off body than the corruption of the grave. This feeling found expression in England through Sir Henry Thompson, who had become a convert to cremation and advocated its adoption. An able reply from Mr. Holland, Medical-Inspector of Burials for England and Wales, opposing the innovation as not being a sanitary necessity, elicited from Sir Henry Thompson a second paper, more powerful in its advocacy than the first. Hence followed an animated discussion of the subject by the press, both in England and America, and a popular interest which has manifested itself in the formation of cremation societies both in London and New York. Simultaneously, the interest has extended itself over Europe, and cremation has found a strong support in Germany, Austria and Switzerland; the first named, with her customary thoroughness, speedily introducing a method far superior to that of Brunetti.

The arguments in favor of cremation are almost exclusively sanitary, being based upon the supposed inadequacy

of burial to prevent the dead from impairing the health of the living. It therefore becomes the obvious duty of all who are in any way concerned with the public health to examine the two methods, in order to ascertain, definitely, whether the continuance of that now in use is really fraught with danger to the community; and, if so, whether the proposed change would satisfactorily remove that danger.

The chief objection to cremation finds its origin in the feeling of repugnance, and even of horror, which is naturally excited in the minds of the majority of civilized people, by the idea of doing violence to the remains of the beloved dead. Among Christians, this feeling is rendered especially strong by the faith in the resurrection; which it is so difficult for the human mind, clinging as it does to symbols, to entirely dissociate from the material body, that this becomes invested with a peculiar sanctity. But this repugnance is mainly due to a habit of the mind, induced by education; and, if burning were once substituted for burying, it is probable that in the minds of the next generation the repugnance would be transferred from the one method to the other. Even now the change is desired by a not inconsiderable number of people; and, as familiarity with the subject increases, this number will doubtless enlarge.

The other arguments beside the sanitary one, which have been adduced in favor of cremation, are, first, that it would prevent premature interment; second, that it would reduce the expense of funerals; third, that it would do away with the exposure of mourners in standing about the grave during the process of interment; and fourth, that the ashes, enclosed in urns, might be kept in dwellings or *columbaria*, safe from the profane touch of the stranger. Sir Henry Thompson boldly advances another, which may be called the agricultural or economico-technical argument; namely, that the ashes might be utilized as a fertilizer.

Of these arguments, the first is the most important, for premature burial is, in the minds of many persons, regarded with the utmost dread; and burning would insure an instantaneous and almost painless death in case it had not already occurred. But the reply has been made that burial alive is of exceedingly rare occurrence, and may be easily rendered

impossible by the general adoption of such precautionary measures as have for many years been in successful operation at the houses of reception at Frankfort and Munich. As for the expense of funerals, that is a matter chiefly regulated by fashion, and would be as great in the one case as in the other; for the mere process of burning the body could scarcely be done more cheaply than that of digging a grave. The third argument is of some weight. The fourth is debatable, for urns may be as easily desecrated as graves. The fifth argument, in proposing to make an article of commerce of the remains of our friends, at once shuts itself out from a hearing.

The opponents of cremation have for arguments, in addition to the *sentimental* one already cited, first, that its adoption, by removing evidences of murder, would tend to the promotion of crime; and, second, that the gases from the cremation-furnace might prove more harmful to the community than any evils connected with burial-places. Of these, the former has a positive weight, which, however, may be so diminished by increased precautions, that it is lightly regarded by the cremationists; and the value of the latter can only be determined by observation of the practical results of the proposed process.

Among the clergy, no uniformity of opinion regarding cremation can be said to exist. By many of this class, it is earnestly opposed on religious grounds. Thus, the bishop of Lincoln, in a sermon preached on the 5th of July last, said that "one of the very first fruits of its adoption would be to undermine the faith of mankind in the doctrine of the resurrection of the body." Others, however, look upon cremation more favorably. Sir H. Thompson says: "Clergymen are anxious to demonstrate how few are the words requiring change in our burial service to render it wholly applicable to cremation." The bishop of Manchester, in consecrating a cemetery on the 22d of March last said: "People who had believed in immortality had, in previous times, burnt the bodies of their dead. He wished his hearers to dissociate the resurrection from physical conditions. Could they suppose that it would be more impossible for God to raise up a body at the resurrection, if needs be, out of element-

ary particles which had been liberated by the burning, than it would be to raise up a body from dust, and from the elements of bodies which had passed into the structure of worms?"

It therefore appears that the only really powerful argument in favor of cremation is the sanitary one; and that against it we have also a sanitary argument, a legal one, and a strong popular prejudice. The essential points, then, in the discussion are these:—

1. Is cremation a practicable and safe method?

2. If so, are the evils necessarily resulting from burial so great as to demand a change?

If to both these questions an affirmative answer can be proved, all objections to cremation become of little value; but if either of them receive a negative answer, we are not justified in advocating any change.

To an investigation of these two questions, the present paper will be devoted; the first division of the subject comprising a brief history of cremation, with an examination of the processes by which it has been accomplished; and the second being a study of the effects of the practice of burial upon the public health. The first will be a mere compilation from various authors, while, in preparing the second, recourse has been had to sanitary literature, to chemical research, and to an extensive correspondence with physicians, especially such as have interested themselves in sanitary subjects. Although the investigation has been the most thoroughly pursued within the State of Massachusetts, assistance has been sought and gladly accepted from all quarters.

CREMATION: ITS HISTORY AND METHODS.

1.—In Ancient Times.

To trace back ancient manners and customs to their origin is always a difficult and often an impossible task; and, in the case of burning the dead, historians have been unsuccessful in fixing the date of its first adoption. That it was not the earliest mode of disposing of the dead is conclusively shown. Our first barbarous preadamite progenitors either exposed their dead to be devoured by the beasts of the field, or did

the eating themselves; in which latter case, the idea of "funeral baked meats" no doubt filled their minds with an unhallowed joy. The first method which indicated any care of the dead was burial, and this we find practised by the ancient Hebrews, Greeks, Romans and Phœnicians. By the Hebrews no other method was ever largely adopted, but with the other nations of antiquity burning became the prevailing custom. When cremation was first adopted by the Greeks is a disputed point. By some it is thought to have been first resorted to during the Trojan war, as a means of carrying the remains of chieftains back to their native country. The first Greek mention of it is Homer's account of the funeral rites of Patroclus and Hector; but Homer evidently did not look upon the process as an innovation, but rather as the common usage. Jamieson* believes that cremation was brought into Greece by the Thracians, by whom that country was largely peopled. Both the Thracians and Phrygians practised it, in advance of the Greeks, and the former are believed to have received it from their progenitors, the Scythians, who inhabited Tartary. Rome, in her earliest days, buried her dead, as Pliny tells us. Remus was buried, according to Ovid; so also was Numa; but the Consul Manlius burnt the body of his son. Cornelius Sylla was the first of the Cornelian family to be burned, B. C. 676. The practice had not been uncommon before, but from this time became more prevalent, reaching its height in the latter days of the republic. The early Christians returned to the practice of burial, and, in the fourth century, when Christianity became fully established, cremation became obsolete. As a general custom, it ceased in the reign of Marcus Antoninus, although, fifty years later, the body of Severus was burned with great pomp. With neither the Greeks nor Romans was burning ever the exclusive custom; but it was esteemed more honorable than burial, and was most common among the upper classes. In striking contrast with this is the fact that the inhabitants of Colchos and Iberia exposed the bodies of those who had done noble actions to be devoured by dogs, but burnt the cowardly.† Plato wrote to

* On the Origin of Cremation. Trans. Royal Society of Edinburgh; vol. viii., 1817.

† Among the *Monto* sect in Japan, at the present day, cremation is practised by the lower classes, but not by the upper.

Socrates that it was a matter of indifference to him whether his body were burned or buried. In Rome, persons who had been struck by lightning, and children who had not cut their teeth, were not burned, but buried.

Among other ancient nations cremation was likewise adopted. In Asia, the practice was very extensive, and has continued till the present day. In Africa, it was accepted by the Carthaginians, and also by the Egyptians, after embalming was discontinued. Other European nations among whom it prevailed were the Celts, Sarmatians, Germans, Gauls, Danes, Swedes and Norwegians. In America, it has long been the practice among certain Indian tribes, and with some of them has not yet been entirely abandoned.

In England, several collections of cinerary urns have been discovered, one of which, in a field in Old Walsingham, Norfolk, exhumed in 1658, was described by Sir Thomas Browne.* The collection consisted of between forty and fifty urns, buried in a sandy soil, not a yard deep nor far apart, and containing about two pounds of bones, with other extraneous objects. These urns bore no date or inscription, but were probably contemporary with the early Roman occupation of the island, although some persons are inclined to consider them as early Saxon or Danish.

The *pyre* was the means by which cremation was, in early times, effected. Among the Romans, this was a pile of rough logs, with four equal sides, of which the law of the twelve tables forbade any polishing or adornment; but they were sometimes covered with dark leaves. The body was placed upon the pile, with the couch upon which it had been carried. The nearest relative, with averted face, applied the torch, and the flames were fed with cups of oil, ornaments, clothing and the favorite viands of the deceased. To these were added various perfumes, which, though forbidden by law, were rendered necessary by the disgusting odor. In the case of an emperor or illustrious general, there was much additional ceremony,—animals were killed and laid upon the pile, and, in the earlier times, captives and slaves. The soldiers marched thrice around the pile, and, in the latter days of Rome, gladi-

* Hydriotaphia—Urn-Burial; 1658.

ators were hired to fight about it. When the burning was completed, the embers were soaked with wine, the bones and ashes of the deceased gathered by the nearest relatives, who sprinkled them with perfumes and placed them in an urn. These urns were often very beautiful and richly decorated; they were commonly of marble, alabaster or baked clay, and bore an inscription beginning with the letters D. M., or D. M. S. (*Dis Manibus Sacrum*).*

The urns were deposited in tombs outside the city, with a few exceptions. Emperors and vestal virgins were permitted to be buried within the walls of Rome. The ashes of Valerius, Publicola and other illustrious patricians were likewise thus privileged; and the right was enjoyed by their descendants, but never used. The private tombs were generally built at the sides of the roads leading to Rome, especially on the Appian Way, where an almost uninterrupted line of tombs extended for many miles from the gates. The public burial-places were the Campus Martius and the Campus Esquilinus, the former containing the ornamented tombs of illustrious citizens buried by the State, and the latter the graves of paupers, whose remains were placed in little pits or caverns, called *puticuli*. The neighborhood of the latter becoming unhealthy through the number of interments, it is recorded that it was given to Mæcenæ, who converted it into a garden, and there built a magnificent dwelling. The tombs of the rich were commonly built of marble, with an open space in front, planted with trees. *Columbaria* were tombs with many niches, like dove-cotes, as the name implies.

In Homer's description of the funerals of Patroclus and Hector, the Greek and Trojan method of cremation is accurately narrated. As frequent reference is made to the burning of the body of Patroclus, we will quote the passage in which it is described:—†

197 " They who had the dead in charge
Remained, and heaped the wood and built a pyre
A hundred feet each way from side to side.

* For representations of a great number of these urns—Greek, Roman and barbarian—the reader is referred to the elaborate work of Montfaucon, "*L'Antiquité Expliquée et Représentée en Figures*." Paris, 1722.

† Iliad, Book XXIII., line 197, Bryant's translation.

With sorrowful hearts they raised and laid the corse
 Upon the summit. Then they flayed and dressed
 Before it many fatlings of the flock,
 And oxen with curved feet and crooked horns.
 From these magnanimous Achilles took
 The fat, and covered with it carefully
 The dead from head to foot. Beside the bier,
 And leaning toward it, jars of honey and oil
 He placed, and flung, with many a deep-drawn sigh,
 Twelve high-necked steeds upon the pile. Nine hounds
 There were, which from the table of the prince
 Were daily fed; of these Achilles struck
 The heads from two, and laid them on the wood,
 And after these, and last, twelve gallant sons
 Of the brave Trojans, butchered by the sword;
 For he was bent on evil. To the pile
 He put the iron violence of fire,
 And, wailing, called by name the friend he loved."

* * * * *

307 * * "They quenched with dark red wine
 The pyre, where'er the flames had spread, and where
 Lay the deep ashes: then, with many tears,
 Gathered the white bones of their gentle friend,
 And laid them in a golden vase, wrapped round
 With caul, a double fold. Within the tents
 They placed them softly, wrapped in delicate lawn,
 Then drew a circle for the sepulchre,
 And, laying its foundations to enclose
 The pyre, they heaped the earth, and, having reared
 A mound, withdrew."

After pyre-cremation, the identification of the ashes, aside from the bones, was impossible; but the Egyptians kept them separate by wrapping the body in a covering of asbestos.

Whether the ancients were actuated by any sanitary motives in their adoption of cremation is a matter of doubt; but that this was one of their motives seems probable, since the earliest Greeks and Romans used their dwellings as tombs. In times of war and pestilence, the sanitary phase of the subject must have presented itself strongly to their minds. Other reasons, however, were probably more weighty. In foreign wars it was necessary to burn the remains of the chieftains, in order to convey them to their homes. This method also permitted the remains to be longer kept in the sight and presence of the mourners than if buried. Another powerful motive was the protection of the remains from indignities, which, in troubled times, they were apt to receive from their enemies;

for instance, Sylla, who had thus served the body of Marius, ordered his own body to be burned to prevent retaliation from the friends of the latter. Other reasons were based upon ancient philosophical and religious ideas. Of the former class, may be cited the belief that the body was by fire most speedily reduced to the first principles, and also the tradition that the world was to be destroyed by fire. To the latter class belong the beliefs that the body was unclean, after the departure of the soul; that by the action of fire the soul was released from all its corporeal bonds, and that the soul itself was thus purified from the contamination which it had contracted in its embodied state. The idea of sacrifice also entered largely into the ceremony of burning.

We have already observed that, as Christianity spread, cremation fell into disuse. The early Christians always buried their dead—at least, there is no positive evidence to the contrary; and those of Rome constructed for this purpose the catacombs, outside the city. They wished to give the remains of their friends the same treatment that was accorded to Christ and the apostles, and therefore adopted the Jewish custom of burial. That their refusal to burn was not connected with ideas of the resurrection is shown by Minucius Felix, who introduces a heathen as saying, "For this reason they execrate the funeral pile and condemn sepulture by burning, as if it precluded the possibility of resurrection." To this Minucius replies, "We do not, as you believe, fear any injury from this kind of sepulture, but we adhere to inhumation as the more ancient and the preferable mode."* It is also stated of the primitive Christians that they objected to cremation that the practice involved the idea of inhumanity to the living. Some of the heathen objected to it on the same grounds, and its employment appears to have been always optional, both in Greece and Rome.

The frequent occurrence of the letters D. M. on the tombs of the early Christians led Merivale to the conclusion that they were in the habit of burning their dead; but Rossi † considers this insufficient ground upon which to support the weight of so new and startling a theory. He surmises that

* Jamieson, *op. cit.*

† Roma Sotteranea, compiled by Northcote and Brownlow, London, 1869.

these letters may have been used carelessly, from custom, without advertence to their real meaning; or the tombstones may have been bought with the letters already inscribed; or that they may have been put on by surviving relatives, ill-instructed in the faith.

2.—*In Modern Times.*

From the fourth century until the most recent times, the funeral pile has remained extinct in Europe, and the dead have been consigned to the earth or the tomb. The first modern reference to the subject was Sir Thomas Browne's essay, "Urn-Burial," published in 1658, and this took merely an historical and metaphysical view of the subject, and did not advocate its revival. In a curious old book, "Philosophical Discourses of the Virtuosi of France," published in English in 1664, conference 240 is upon the subject, "Whether it be better to bury or to burn the bodies of the dead." In the discussion, which is chiefly of a sentimental character, one disputant advocates cremation, as preventing contagion, and another opposes it, as likely to corrupt the purity of the air. The subject is not again heard of, except in antiquarian researches, such as the splendid work of Montfaucon, published in 1722, until the French Revolution, when the minds of this people, thirsting for change, and with a special taste for classic customs, turned to cremation as an innovation to be desired. In the fifth year of the Republic (1796), Legrand d'Aussy, in a memoir on "National Sepultures," declared the necessity of substituting incineration for burial. In the same year, a committee of the council of the five hundred was deputed to project a law for this reform; and the Institute of France offered a prize of 1,500 francs for the scientific study of the question. Of the forty authors who offered memoirs in competition for this prize, all favored the adoption of the system, provided that its employment be made optional, so as not to conflict with the principles of liberty. It does not appear, however, that the investigation, at this time, bore any practical fruit.

But, on the 8th of July, 1822, a veritable cremation, whose fame is world-wide, occurred in Italy, on the shore of the Mediterranean. The poet Shelley, and his friend Wil-

liams, having been drowned by the upsetting of a boat near Leghorn, their bodies were washed ashore, and were there burned by Byron, Leigh Hunt and Trelawney. This act was in compliance with the quarantine laws of Tuscany, which required that everything drifting from the sea should be burned. The process, with many revolting details, is minutely described by Trelawney.*

In 1856, an earnest discussion of the subject of cremation again arose in Paris. A new journal, "La Cremation," was established, devoted to the advocacy of burning, and the medical journals took up the subject with interest. M. Caffé was the chief partisan of the reform, and urged that the subject be calmly discussed, especially in overgrown capitals, like London and Paris. The project was opposed by the "Gazette Hebdomadaire," on the grounds that it would be more difficult on the battle-field than burial, and that the emanations resulting from the process would be far from innoxious. A "sarcophæbus," with a metallic table, instantaneous slide and concealed furnace, was, at this time, proposed.

At the same time, an interest in the subject was also felt in Italy. In January, 1856, Prof. Coletti, rector of the University of Padua, presented to the Academy of Science and Letters of that city, a memoir earnestly advocating cremation.†

The subject was soon laid aside, however, and not revived until 1866, when Dr. Giro‡ published an article in which he contended that burial is a practice "in opposition to humane sentiments, hygiene, and the civil life of nations." In the following year appeared a paper by Du Jardin§, of Genoa, in which he approved the ideas of Coletti.

But the grand revival of the question did not occur until 1869, when it was presented to the Medical International Congress of Florence, by Profs. Coletti and Castiglioni, "in the name of public health and of civilization"; and a resolution was passed expressing a wish that "every possible means be employed to obtain legally, in the interest of the laws of hygiene, that the incineration of bodies should be

* Recollections of the Last Days of Shelley and Byron.

† Sulla Cremazione dei Cadaveri.

‡ Sulla Incinerazione dei Cadaveri. ["Gazz. Med. Ital.," prov. Venete. 1866.]

§ Sulla Cremazione dei Cadaveri. ["La Salute." Genoa. 1867.]

substituted for the present system of inhumation." In the following year, papers were published by Castiglioni* and Du Jardin,† the latter calling attention to the defective condition of many cemeteries of the kingdom. In France, in the same year, in consequence of the fatal war then in progress, the question of burning the dead naturally presented itself. It was proposed by Dr. Lapeyrère, who styled it "this mode, unpopular in our religion, but before which the Hebrews (our parents in religion) do not hesitate, in view of preventing contagion." The attention of the council was called to the "necessity of the immediate adoption of cremation" by Inspector Laveran, director of the school of Val de Grace. Baron Larrey, surgeon-in-chief of the army of Paris, to whom the subject was referred, made a report in May, 1871, in which he showed the necessity of choosing for a cemetery a permeable soil, adapted for drainage, in which will be dug deep ditches, liberally strewn with quicklime, which will give rise to a slow combustion. This would be, he said, a true "latent cremation," unperceived in its effects, which will offend neither religious beliefs nor local prejudices. These ditches should be covered with a layer of earth thick enough to neutralize the emanations of volatile principles and favor vegetation.

After the battle of Sedan, burning was resorted to in a very imperfect manner by the Prussians; but Dr. Parkes‡ states that the experiment appears to have been unsuccessful. The same may be said of the attempt made at Dresden, in 1871, to burn animals, victims of the cattle-plague.

At the Medical Congress, held at Rome in 1871, a similar resolution was passed to that adopted at Florence the preceding year. At this time, also, appeared a paper by Dr. Pini,§ of Milan, advocating cremation.

In 1872, Italian papers advocating the practice of burning were produced by Drs. Ayr,|| Valeriani,¶ Peyriani,** and

* Sulla Cremazione dei Cadaveri. 1870.

† La Guerra e le sue Vittime, l'Incinerazione ed il Seppellimento. 1870.

‡ A Manual of Practical Hygiene. 1873. p. 442.

§ La Cremazione dei Cadaveri. ["Gazz. de Milan." 1871.]

|| La Cremazione e l'Igiene. Milan. 1872.

¶ Sulla Incinerazione dei Cadaveri. ["Opinione." Florence. 1872.]

** La Cremazione dei Cadaveri. ["Il Presente." Parma. 1872.]

Polli,* and one opposing it by Dr. Rota.† The most important of these papers was that of Dr. Polli, of Milan, which was not only a complete study of the subject, but also contained the first experimental researches. His experiments were performed at the Milan gas-works on dogs, and differed from the ancient method only in the substitution of gas for wood, whence the apparatus is known as the "gas-pyre."

In 1873, the interest in cremation had become very earnest and wide-spread in Italy, both among scientific men and the public at large. The Royal Institute of Science and Letters of Lombardy, had offered the quinquennial (1877) Secco-Commeno prize to the advocates of cremation for the best practical method. The same Institute offered the following declaration to the two chambers of deputies of the kingdom: "The Lombardy Institute, profoundly convinced that the adoption of the process of cremation will mark a stage of progress in the march of civilization, hopes that the government will make all efforts that Italy may be the first to adopt it, and thus set the example to other civilized nations."

In April, 1873, Prof. Maggiorani succeeded in inserting in the new sanitary code for the kingdom of Italy, then under discussion, an article granting permission for families to adopt the process of cremation, the consent of the Superior Council of Health having been first obtained.

Meanwhile, Italian authors and experimenters were busy with the subject. Papers advocating cremation were published by Drs. Formari,‡ Musatti,§ Annelli,|| Giacchi,¶ Pini,** Amati,†† and Brunetti.‡‡ The other side was represented by Prof. Zinno,§§ of Palermo, a zealous advocate of embalmment, and enemy of cremation. The hostility of the Church to this system also found vigorous expression in the

* Sulla Incinerazione dei Cadaveri. Memoir presented to the Royal Institute of Lombardy. 1872.

† L'Incinerazione dei Cadaveri è Ammissibile? Chiari. 1872.

‡ Humatio vel Crematio. Turin. 1873.

§ Intorno alla Cremazione dei Cadaveri. Venice. 1873.

|| La Cremazione dei Cadaveri. Milan. 1873.

¶ La Cremazione dei Cadaveri. Florence. 1873.

** La Cremazione dei Cadaveri. ["Annali Universali di Medicina." 1873.]

†† Sulla Cremazione dei Cadaveri. Milan. 1873.

‡‡ La Cremazione dei Cadaveri. Padua. 1873.

§§ Inumazione, Inbalzamazione e Cremazione dei Cadaveri. Naples and Palermo. 1873.

"Osservatore Cattolico," of Milan. The practical work of the year was done by Prof. Gorini, of Lodi, and Prof. Brunetti, of Padua.

Gorini's experiments were made at his laboratory, in September, 1873, and witnessed by a brilliant assembly of scientific men. He first fused in a crucible, at a very high temperature, a substance whose composition is a secret, but which has been conjectured to be a mixture of caustic soda with nitre or chlorate of potash. When fusion had been carried to the point of ebullition, portions of a human body, legs, arms, etc., were thrown in, and completely destroyed in twenty minutes, the solid parts remaining on a metal grating at the bottom of the crucible. The heat was obtained from coke. The combustion was not attended with any crackling sound or offensive odor.

The results of Prof. Brunetti's experiments were exhibited at the Vienna Exposition, and attracted great attention. His apparatus consisted of an oblong furnace, built of refracting brick, furnished with ten side-openings to regulate the draught. In the upper part, was a cornice of tiles to support an iron framework, on which the body was placed, and the whole was covered with a dome-shaped roof; wood was used as fuel. Carbonization was complete in two hours; the body was then reduced to fragments, and, after two hours more, incineration was complete. The bones exhibited at Vienna were white, with a smooth, sharp fracture. From a man weighing ninety pounds, a little more than four pounds of ash was obtained, after the consumption of from one hundred and sixty to one hundred and eighty pounds of wood.

In 1873, cremation was also advocated in France, by Pietra Santa,* and in Belgium by the "Gazette de Bruxelles."

The opening of the year 1874 found the subject of cremation engrossing a more and more widely-spread interest. A public meeting at Milan, projected during the previous year, was held April 6. Over five hundred persons, of all classes of society, were present. After addresses by Drs. Polli, Coletti, Musatti and others, this vote was unanimously passed:—"That the Italian government, in the next discussion of the new Sanitary Code, already approved by the Senate,

* La Cremation des Morts en Italie. ["Union Médicale." Paris. 1873.]

admit to Article 185, as optional, cremation of the dead, under the immediate surveillance of the syndics of the communes." One pleasing idea, in connection with cremation, was developed at this meeting, in a letter from Prof. Amati, who said, "Dr. E. Lombardi, Sicilian poet, assures me that, with certain people, the habit has existed of planting seeds of small flowering-plants in the ashes of the dead. These germinated, grew and expanded, and finally were gathered, to be religiously preserved by the family." During the present year, additional papers upon this subject have been published by Dell' Acqua,* Biondelli,† Foldi,‡ Musatti,§ Pini,|| Pisani¶ and Golfarelli.** The last mentioned refers to a case in which the superior council of health, when asked to authorize the removal to Italy of a person who died of yellow fever in America, gave its consent, on condition of the previous incineration of the remains.

In Austria, an enthusiasm was speedily kindled by Prof. Brunetti's specimens at the Exposition. In February last, the Communal Council of Vienna adopted, unanimously, the following resolution:—"Apropos of the buildings to be constructed in the new central cemetery of the city, the Superior Administration will take the necessary measures that, with the least possible delay, optional cremation may be effected." Moreover, the Imperial Academy of Medicine has made a pressing appeal to the chemists and hygienic physicians of Austria and Hungary, for a serious study of the principles of the question. Articles on the subject have appeared in Vienna, by Lanyi,†† Witlacil‡‡ and others.

Switzerland, too, has caught the infection; the most ardent champion of cremation, in that country, being Dr. Wegmann-Ercolani,§§ who published, early in the year, a pamphlet upon

* La Cremazione dei Cadaveri. ["Il Medico di Casa l'Igea." Milan. April, 1874.]

† La Cremazione dei Cadaveri Umani. Milan. 1874.

‡ La Cremazione dei Cadaveri. ["Il Sole." Milan. 1874.]

§ Intorno di Progressi della Cremazione dei Cadaveri. ["Giorn. Venet. dei Scien. Med." 1874.]

|| Sulla Cremazione dei Cadaveri. ["La Salute." Genoa. 1874.]

¶ La Cremazione dei Cadaveri. ["Gazz. Med. Ital. Lombard." 1874.]

** Sulla Cremazione dei Cadaveri. Florence. 1874.

†† Ueber die Verbrennung der Leichen am Schlachtfelde. ["Allg. Militar-artzl. Zeitg." Vienna. 1874. XV., p. 92.]

‡‡ Ueber Leichenverbrennung. ["Wien. Med. Presse." 1874. XV., p. 361.]

§§ Die Leichenverbrennung als rationnellste Bestattungsart. Zürich. 1874.

the subject, besides contributing various articles to the daily papers. As a result of his zealous efforts, two cremation societies have been formed, one at Zürich and one at Aarau. At meetings held at Zürich, on the 7th and 10th of March, it is said that more than 2,000 persons were present, and the popular interest was very great.

In Germany, the principal writers upon the subject, during the present year, have been Reclam,* of Leipzig; Fleck† and Küchenmeister,‡ of Dresden, and Ullersperger,§ of Erlangen. Of these, the first named has made the most notable contribution to the science of cremation, by introducing, for its practical application, the Siemens furnace, which has been used with success in the working of iron and glass. By means of it, an enormously high temperature can be obtained, at the expense of a small amount of fuel, even though this be of inferior quality. Peat, wood or charcoal may be used. The principle of the furnace is called that of "regenerative heat," and its essential parts are three chambers, called respectively the *generator*, *regenerator* and *combustion chamber*. The fuel is placed in the generator, a species of brick oven, where it is burned with a limited access of air, whereby a combustible gas is produced, consisting chiefly of carbonic oxide, nitrogen and carburetted hydrogen. This escapes from the generator and enters the regenerator at a temperature of 150° to 200° C. This second chamber is of cubical shape, with walls of stone, and the interior filled with a network of horizontal and vertical bars. By contact with the combustible gases, this chamber becomes so intensely heated that the gases enter the combustion chamber, where the body is placed, at a temperature of 3,000° C. From this they pass to the chimney, through a second regenerator, where all noxious vapors from the corpse are consumed. Reclam caused one of these furnaces to be specially arranged for purposes of cremation, by the construction of an apartment above, from which the body could be lowered directly into the combustion chamber. Of this method, Prof. Reclam

* De la Crémation des Cadavres. ["Monit. Scientifique." Paris. 1874. IV., p. 484.]

† Beitrag zur Beantwortung der Frage von der Leichenverbrennung. ["Allg. Zeitsch. für Epidemiol." Erlangen. May and June, 1874.]

‡ Ueber Leichenverbrennung. Erlangen. 1874.

§ Urne oder Grab. Erlangen. 1874.

says that it "is the simplest and most satisfactory to the bereaved. Before the friends assemble, the body is lowered into an empty space, containing only air raised to white heat, in which it burns odorless, and the ash alone remains. Heated air alone escapes; there is neither vapor nor smoke, the combustion is so perfect."

The cost of this furnace is estimated at \$1,250, and the time required for the combustion of a human body, one hour. By means of it, at a cost of seventy-five cents for fuel, two hundred pounds of animal tissue have, in the space of an hour and a half, been reduced to white ashes, without sound or smell.

Two genuine acts of cremation in Dresden, by means of this furnace, have been reported: the wife of Sir Charles Dilke being the subject in one case, and the wife of a German physician in the other. The following accounts of the latter case is taken from one of the daily papers.* "The hall around the furnace was decorated with flowers, and in every other respect the solemnity which should attend so serious a rite was duly observed. The process of cremation was screened from the eyes of the lady's friends by an iron door. There was no smoke nor any unsightly transformation of the body. When the coffin was consumed, the body appeared in its natural state, then red-hot, and at last appeared to be of translucent white. From this it crumbled into ashes. Up to the period of its entire consumption by the flames, the process was merely as a rapid drying up. After seventy-eight minutes, all organic matter was gone, and nothing remained but a small heap of ashes, which was conveyed away in an urn." This occurred on the 6th of November. Shortly after, the government of Saxony forbade the practice of cremation.

The adoption of cremation has been proposed at one of the Jewish cemeteries at Berlin; but we are not aware that the ceremony has yet been performed.

In France, the interest in cremation has not become general. Pietra Santa has followed his paper of last year with a second.†

* "Boston Daily Advertiser," December 1, 1874.

† *La Crémation en France et à l'Etranger*. ["*Annales d'Hygiène Publique*." Paris, July, 1874, p. 179.] To this paper we are indebted for much valuable information relating to the recent history of the subject.

That the new system is not entirely devoid of support in that country, is shown by the following extract from the report presented to the council of Paris, early in the present year, by Mr. Hérold, upon the project of creating a cemetery at Méry sur Oise.

"It is not without regret that some members of the commission have had to forego proposing to you the examination of the system of cremation. In their estimation, cremation would not only have the incontestable advantage of simplifying the solution of the material question in the twofold point of view of salubrity and space, but also, far from interfering with the affectionate remembrance of the dead, it would facilitate its exercise, and, consequently, render it more general. Besides, if prejudices against cremation exist, this would only be a reason for not rendering it obligatory, but not for interdicting it."

The honor of being the first and chief promoter of cremation in England belongs to Sir Henry Thompson, an eminent surgeon and physicist, whose brilliant paper, entitled "The Treatment of the Body after Death," in the "Contemporary Review," for January, 1874, at once aroused public interest, and drew forth a large measure of approval and some vigorous opposition. He based his advocacy of cremation upon these grounds:—That the disposition of the remains in no wise concerns the deceased, the survivors being the only interested parties; that all dead animal matter becomes ultimately resolved into carbonic acid, water, ammonia, etc., which are gaseous and mingle with the atmosphere, and mineral constituents, which remain where the body lies, until dissolved and washed into the earth by rain; that this is a process of combustion or oxidation, and is essentially the same, whether completed in a few hours or thousands of years; that in the slow process of decomposition which occurs after burial, intermediate poisonous compounds are formed, which, by tainting the air and the water, are a source of danger to survivors, and that hence the public health demands that burial should be discontinued and cremation adopted. He considers that the prohibition of intra-mural interment is but a step in the path of progress, and also that extra-mural cemeteries are certain, from the rapid growth of cities and towns, soon to be surrounded with dwellings, and ultimately

built upon. To quote his own words :—" At present, we who dwell in towns are able to escape much evil by selecting a portion of ground, distant, in this year of grace 1873, some five or ten miles from any very populous neighborhood, and by sending our dead to be buried there,—laying by poison, nevertheless, it is certain, for our children's children, who will find our remains polluting their water-sources, when that now distant plot is covered, as it will be, more or less closely, by human dwellings."

Sir Henry takes also an economic view of the subject. He computes that 80,430 persons who died in London in 1871, would furnish about 206,820 pounds of ashes and bone-earth, equivalent to six or seven times its weight of dried and unburned bones, as they ordinarily exist in commerce; and that the utilization of this for fertilizing purposes would save an enormous annual outlay for the importation of bones, the value of such bones imported in 1872 amounting to £753,185, or nearly four million dollars. He includes in the economic argument the expense of funerals, which he estimates at an average, in London, of £10, or £800,000 for the past year. He believes the adoption of cremation would greatly reduce this expense. The prevention of premature burial he likewise alludes to as a reason for adopting cremation.

In the February number of the same review, Mr. Philip H. Holland* replies to the paper of Sir Henry Thompson, contending that cemeteries, if properly cared for, are in no wise injurious; that well-water is far more likely to be contaminated by cesspools and drains than by graveyards, and that the gases arising from graves are no more than can be taken up by the vegetation. As regards "our children's children," he does not believe the present cemeteries will ever be built over, but will be, when full, reserved as public parks. The economic view of the subject, he questions Sir Henry's seriousness in proposing. In reference to the saving in ashes and bone-earth by cremation, he says: "If this is not meant to be a suggestion that we use our fathers' ashes as a turnip-dressing, which would be worse than to 'botanize on a mother's grave,' it is hard to see what is intended; and if that

* Burial or Cremation? A Reply to Sir Henry Thompson, by Philip H. Holland, M.B.C.S., Medical Inspector of Burials. ["Contemporary Review," February, 1874.]

be what is meant, why stop there? Why not, as we easily might, reduce to powder the flesh as well as the bones of our relatives and friends, to be used as a substitute for guano, thereby saving the whole amount of £700,000 a year; which, divided amongst the thirty million inhabitants of the British Isles, would amount to the magnificent sum of sixpence a head every year, obtained at the trifling cost of outraging family affection, and desecrating what most of us regard with tender reverence?"

This paper elicited from Sir Henry Thompson a vigorous rejoinder,* in the March number of the same magazine, in which he reiterated and fortified his previous arguments, and also described the process of cremation, as performed under his own direction. By means of a powerful reverberating furnace, he succeeding in reducing two bodies of animals, weighing respectively 47 and 140 pounds, to an amount of ashes weighing, in the one case, $1\frac{3}{4}$ pounds, and in the other, 4 pounds. The time consumed was less than an hour; no trace of odor was perceived, and of the ashes he says:—"Nothing can be more pure, tested by sight or smell, than they are, and nothing less suggestive of decay or decomposition. It is a refined sublimate, and not a portion of refuse, which I have before me."

He adds: "In the proceeding above described, the gases which leave the furnace-chimney during the first three or four minutes of combustion are noxious; after that time they cease to be so, and no smoke would be seen. But those noxious gases are not to be permitted to escape by any chimney, and will pass through a flue into a second furnace, where they are entirely consumed: and the chimney of the latter is smokeless,—no organic products whatever can issue by it. A complete combustion is thus attained. Not even a tall chimney is necessary, which might be pointed at as that which marked the site where cremation is performed. A small jet of steam quickening the draught of a low chimney is all that is requisite. If the process is required on a large scale, the second furnace could be utilized for cremation also, and its products passed through another, and so on without limit."

This ardent investigator subsequently employed the Sie-

* Cremation: A Reply to Critics, and Exposition of the Process.

mens furnace, of which we have already spoken. In describing its working in his hands, we cannot do better than again to borrow his own words :—

“By means of one of the furnaces invented by Dr. Wm. Siemens, I have obtained even a more rapid and more complete combustion than before. The body employed was a severe test of its powers, for it weighed no less than 227 pounds, and was not emaciated. It was placed in a cylindrical vessel, about seven feet long by five or six in diameter, the interior of which was already heated to about 2,000° Fahr. The inner surface of the cylinder is smooth, almost polished, and no solid matter but that of the body is introduced into it. The products, therefore, can be nothing more than the ashes of the body. No foreign dust can be introduced,—no coal or other solid combustible being near it; nothing but heated hydrocarbon, in a gaseous form, and heated air. Nothing is visible in the cylinder before using it but a pure, almost white interior, the lining having acquired a temperature of white heat. In this case, the gases given off from the body, so abundantly at first, pass through a highly heated chamber among thousands of interstices made by intersecting fire-bricks, laid throughout the entire chamber, lattice fashion, in order to minutely divide and delay the current, and expose it to an immense area of heated surface. By this means they were rapidly oxidized, and not a particle of smoke issued by the chimney. No second furnace, therefore, is necessary by this method to consume any noxious matters, since none escape. The process was completed in fifty-five minutes, and the ashes, which weighed about five pounds, were removed with ease.”

In making these experiments, the bodies of the lower animals were employed.

Sir Henry defends cremation from the charge of being an incentive to crime, in destroying the proof of murder by poisoning, and contends that this danger would be completely obviated by the appointment of inspectors, without whose written permission no burial can take place. His summing up is as follows :—

“For the purposes of cremation, nothing is required but an apparatus of a suitable kind, the construction of which is

well understood and easy to accomplish. With such apparatus the process is rapid and inoffensive, and the result is perfect. The space necessary for the purpose is small, and but little skilled labor is wanted.

"Not only is its employment compatible with religious rites, but it enables them to be conducted with greater ease and with far greater safety to the attendants than at a cemetery. For example: burial takes place in the open air, and necessitates exposure to all weathers, while cremation is, necessarily, conducted within a building, which may be constructed to meet the requirements of mourners and attendants in relation to comfort and taste.

"Cremation destroys instantly all infectious quality in the body submitted to the process, and effectually prevents the possibility of other injury to the living from the remains at any future time. All care to prevent such evil is obviously unnecessary, and ceases from the moment the process commences. The aim of cremation is to prevent the process of putrefaction.

"On the other hand, burial cannot be conducted without serious risks to the living, and great care is required to render them inconsiderable with our present population. Costly cemeteries also are necessary, with ample space for all possible demands upon it, and complete isolation from the vicinity of the living, to insure, as far as possible, the absence of danger to them.

"It is a process designed essentially to prolong decay and putrefaction with all its attendant mischief; and the best that can be affirmed of it is, that, in the course of many years, it arrives, by a process which is antagonistic to the health of survivors, at results similar to, but less complete, than cremation produces in an hour, without injury to any."

These papers aroused a very considerable interest in cremation both in England and America. A cremation society was formed in London, whose secretary, Mr. Wm. Eassie, C. E., has written a paper on the subject.*

* Cremation in its Bearings upon Public Health. ("British Medical Journal," Aug. 1, 1874.) Other valuable papers have appeared in the "London Medical Record" for Jan. 14, and II. p. 14, 1874, and the "Medical Times and Gazette" I. p. 181 and I. p. 510, 1874, besides references to the subject in the "Lancet" for July 11, Aug. 15 and Aug. 22, 1874; also a sharp criticism of Sir Henry Thompson's first paper in the "Spectator" for Jan. 3, 1874.

In the United States, the interest in cremation does not appear to be as yet very general or profound. The most complete papers upon the subject which have appeared in this country are those of Professor Frazer,* of Philadelphia, and Dr. Bayles,† of New York, who give it their approval. Numerous references to the subject can be found in the various medical journals and daily papers, during the first half of the present year, almost entirely in the form of reviews or translations of foreign publications. Some journals approve and others disapprove of the new process, but the majority appear to give it a qualified approval. The daily press has appeared to regard it rather as a curiosity; and, the novelty having worn off, the references to it during the latter half of the year have been few.

On the 3d of April last, a meeting was held in New York of those favoring the practice of cremation, and steps were taken for the formation of a cremation society.‡

No case of cremation has yet occurred in the United States, although one was reported in Philadelphia, in April last, Pietra Santa alluding to it as a genuine case.

To recapitulate: the modern methods of cremation, all of them introduced during the past three years, are the following:

1. The gas-pyre of Polli, the process lasting several hours, giving rise to a thick smoke and offensive odor. Complete incineration was with difficulty effected.

2. Gorini's method, by means of chemical reagents in a state of fusion. The burning was completed in twenty minutes, and no unpleasant odor resulted. The fuel used was coke. We are not aware that a whole body has ever been treated in this way. The method is said to be expensive, owing to the cost of the chemicals and the large amount of fuel requisite to bring them to the point of ebullition.

3. Brunetti's method, with a brick furnace and wood as fuel. The process lasted four hours, and required the artificial reduction of the body to fragments to render it complete. The amount of fuel was small, 160 to 180 pounds.

* The Merits of Cremation. ["Penn. Monthly," June, 1874.]

† Disposal of the Dead. ["Sanitarian," June, 1874.] Also, Cremation and its Alternatives. ["Popular Science Monthly," June, 1874.]

‡ See New York papers of April 4, 1874.

4. Sir Henry Thompson's method, by means of an ordinary reverberating furnace, a second furnace being necessary to consume the smoke and noxious gases. The burning occupied less than an hour, and incineration was complete.

5. Cremation by means of the Siemens furnace, practised by Reclam, of Leipzig, Sir Henry Thompson, and Siemens himself. The time required is fifty-five or sixty minutes. Inferior fuel may be used. Incineration is complete, and no smoke nor noxious vapors escape.

The methods practised by various Asiatic nations, at the present day, differ but little from the pyre-cremation of the ancients. The most complete review of these customs is said to be furnished by Biondelli.* Burning is practised by the Hindoos, Siamese, Japanese, Chinese, Tartars and others.

II.—INTRA-MURAL INTERMENT.

That the evils arising from interment are chiefly due to the Christian system of intra-mural sepulture is perfectly evident; for the nearer the abodes of the living and of the dead are brought together, the more likely are the latter to contaminate the air and water used by the former. So glaring have the pernicious effects of this system become, that, in nearly all of the large cities of Europe and America, spacious rural cemeteries have taken the place of the old, crowded, intra-mural churchyards. The change, however, has not yet become universal, and, as some of the old graveyards in populous districts are still in use in Massachusetts, we will briefly review the history of the intra-mural system.

Among the ancients, burial within cities was seldom practised. It was forbidden by the Roman law, and among the Greeks was only practised by the Lacedemonians, who were taught by Lycurgus to bury in the city and erect monuments, to familiarize the youth with the spectacle of death, and that they might remember and emulate the heroic deeds of their fathers. The Jews buried in caves and fields, remote from dwellings, and the Egyptians in catacombs and pyramids. To the inhabitants of Syracuse, in Sicily, the custom of extra-mural interment once proved of the greatest practical value. When the city was besieged by the army of

* *La Cremazione dei Cadaveri.* Milan. 1874.

Hannibal, the enemy, in order to build a wall to command the city, destroyed the tombs used by a city of 200,000 inhabitants. The bodies were scattered about the plain and gave rise to a frightful epidemic, which carried off Hannibal and great numbers of his followers.

The primitive Christians of Rome buried in catacombs, subterranean passages excavated for the purpose in the hills around the city. There were, in the third century, 25 or 26 of these, corresponding with the number of parishes within the city, and measuring, in the aggregate, about 350 miles in length. They were frequented as shrines till the translation of relics to the churches, A. D. 750, when they became neglected and forgotten, remaining in oblivion for nearly seven and a half centuries, till rediscovered in 1578.

As Christianity spread, the desire of the faithful to be buried within the hallowed precincts of the churches, produced occasional infractions of the Roman law against burial in cities. To the Emperor Constantine the privilege of being buried in the vestibule of the Church of the Apostles, at Constantinople, was accorded as the crowning honor of his career. For many years this privilege was only permitted to persons of the greatest fame, piety or wealth, the last securing it by splendid gifts to the church. The Emperor Theodosius, in the year 381, forbade interment in cities, and ordered the removal of the remains to prevent infection. This law was soon enforced throughout the Roman empire, and was subsequently embodied in the Justinian code. No cemetery was permitted in or near the city of Rome until the year 509, when Pope Marcellus obtained permission from the senate to found the first Christian cemetery in Rome. From this time burial in churches became more and more common, superstition overcoming all sanitary considerations, until the condition of the churches became a crying evil. To priests was accorded the right of burial in the choir, to monks in the galleries of the convents, and the founder of a church was allowed to be buried in the holy place. Under Charlemagne, Theodolphus, bishop of Orleans, found the churches almost converted into catacombs, and became convinced that, unless this use of them were discontinued, they would have to be relinquished as places of worship. He had

the tombs destroyed, and made a regulation that neither priest nor layman should be buried in a church unless distinguished for holiness of life. In 787, Charlemagne deprived laymen of the privilege of burial in churches, and afterwards made the law apply to all persons indiscriminately. From the eighth to the eighteenth century, however, there was a constant tendency to relaxation of discipline in this regard, men thinking by burial in sacred soil to atone for the wickedness of their lives. The decrees of a score of ecclesiastical councils were issued against this pernicious system, but without any permanent effect. In the ninth century the council of Arles permitted interment in churches to ecclesiastics and laymen of the highest distinction; and that of Nantes allowed tombs and monuments only in the vestibules and porches of churches. The council of Tribur exhorted the nobles to rest satisfied with burial in the vicinity of cathedrals or convents, and not to desire to lie within the walls. But, despite all efforts to the contrary, the custom of burial in and about churches became, during the middle ages, firmly established. Those who could not be buried in the church itself were deposited in the enclosure about it, resting, if not before the shrine of their patron saint, at least in the shadow of the sacred edifice.

Thus originated the Christian churchyard, often a contracted plot of ground in the midst of dwellings, literally packed with bodies until it became impossible to dig a grave without disturbing human bones; and the earth so saturated with foul fluids, and the emanations so noxious, as to make each churchyard a focus of disease.

In the eighteenth century the attention of the medical profession was drawn to the magnitude of this evil, and governments were induced to take some active measures for reform. The lead was taken by Austria, interments in the city of Vienna being forbidden during the reign of Maria Theresa—about 1730.* Shortly after, an agitation of the subject was commenced in France, by Haguénot,† a physician of Montpellier, who described a frightful case in which three men

* For the titles of numerous German and Dutch works upon intra-mural interment, see the bibliography at the close of this paper.

† *Mémoire sur le Danger des Inhumations dans les Eglises.* Montpellier. 1748.

died, and two others narrowly escaped death, from entering a freshly-dug grave in the parish churchyard in that city, on the 17th of August, 1744. He was followed by Drs. Maret,* of Dijon, in 1773, and Navier,† of Chalons, in 1775, showing the evils of burial in crowded churchyards. In 1765, the parliament of Paris issued a decree requiring all churchyards in that city to be closed, and to remain unoccupied for five years, or longer if thought necessary by proper officers and physicians. Eight cemeteries were to be established at a distance from the city, the graves not to be marked by stones, but all epitaphs and inscriptions to be placed on the stone walls, eight feet high, enclosing the grounds. Each cemetery was to have a place of deposit in the city, whence bodies were to be removed at 2 A. M. in summer and 4 A. M. in winter. Louis XV. concurred in the prohibition of graveyards in Paris, and granted to the parish of St. Louis, at Versailles, 3,600 square feet of ground in the forest of Sartori, as a cemetery. Louis XVI., in March, 1776, prohibited graveyards in cities, towns, chapels and cloisters, on sanitary grounds; but made an exception in favor of the clergy, lords and patrons of churches, who were allowed to be buried under vaults covering a space of seventy-two square feet, built of stone and flagged, the bodies being placed six feet under the lower pavement.

In 1785 a general disinterment was commenced in Paris, the bodies being removed from the various cemeteries and transferred to the catacombs,—subterranean galleries under the northern part of the city, somewhat similar to those of Rome, except that the latter were without the city and constructed especially for purposes of burial, while the former are within the city and are merely disused quarries. The disinterment was begun in the cemetery of the Innocents, which had been in use for three centuries. The neighborhood had become very unhealthy and the air extremely offensive. Candles would not burn in the cellars of adjacent houses. Although the exhumation was performed in

* *Mémoire sur l'Usage où l'on est d'enterrer les Morts dans les Eglises et dans l'Encinte des Villes.* Dijon. 1773.

† *Reflexions sur les Dangers des Exhumations précipitées, et sur les Abus des Inhumations dans les Eglises; suivies d'Observations sur les Plantations d'Arbres dans les Cimétieres.* Amsterdam and Paris. 1775.

winter, a number of grave-diggers were killed on the spot by the poisonous gases. Several years before, the neighbors had begun to complain of the offensiveness of this cemetery. Since the removal of the bodies from this place, the vicinity has become very healthy.

In 1790, the National Assembly passed a law commanding all towns and villages to discontinue the use of their old burial-places, and to form others at a distance from their habitations; and, in 1804, an imperial decree was issued, ordering high ground to be chosen for cemeteries, and every corpse to be interred at a depth of at least five or six feet.

In 1805, was published a work by Vicq d'Azyr,* showing the evils of intra-mural burials. This was chiefly a translation from the Italian of Scipion Piattoli, who had, in his turn, drawn upon the French authors already mentioned.

Since the discontinuance of the old cemeteries, Paris has made use of the four suburban cemeteries of Père la Chaise, Montparnasse, Montmartre and Vaugirard, which have, since they were opened, received in the aggregate a million and a half of bodies. Besides being overcrowded, these have, with the spread of the city, become also intra-mural, and it has become necessary, during the past year, to establish a new rural cemetery at Méry sur Oise, twelve miles from the city.

The example of France in abolishing intra-mural cemeteries was soon followed in the United States, our country preceding England in this reform. In 1806, a report of the New York Board of Health, by Miller, Pintard and Van Zandt,† advised the removal of all graveyards from the city, and suggested that the present burial-places be made public parks. As a result of this report, a law was passed authorizing the corporation to prohibit interment in the city; but this law soon became a dead letter, and was not enforced until the publications of Dr. F. D. Allen,‡ in 1822, and Dr. Felix Pascalis,§ in the following year, had awakened a new and lively interest in the subject. Among the instances of the

* *Essai sur les Lieux et les Dangers des Sépultures. Oeuvres de Vicq d'Azyr* Vol. VI., 1805.

† *On Interments within the Populous Parts of the City of New York.* 1806.

‡ *Documents and Facts, Showing the Fatal Effects of Interments in Populous Cities.* New York, 1822.

§ *An Exposition of the Dangers of Interment in Cities.* New York, 1823.

injurious effect of cemeteries cited in the first-named paper, was the following:—In 1814, a battalion of militia was stationed on a lot on Broadway, the rear of which bounded on Potter's-field, from whence arose a most deadly effluvium. A number of soldiers were attacked with diarrhœa and fever. They were removed at once; one of the sick died, and the others rapidly recovered.

In a letter from Dr. Joseph Akerly, embodied in the same paper, the writer expressed the belief that Trinity churchyard had been an active cause of the yellow fever in New York in 1822, aggravating the malignity of the epidemic in its vicinity. This church was built in 1698, and the ground had been receiving the dead for one hundred and twenty-four years. Sometimes bodies were buried only eighteen inches below the surface, and it was impossible to dig without disturbing the remains. During the Revolutionary War, this burial-ground had emitted pestilential odors, and, in 1781, Hessian soldiers were employed to cover the ground with a layer of earth, two or three feet in depth. This ground was unusually offensive in 1822, and annoyed passengers on the surrounding streets, previous to the appearance of the yellow fever, in July. During the epidemic, the condition of this churchyard, and the virulence of the disease in its vicinity, called for some active measures, and, on the night of September 22, Dr. Roosa covered the ground with fifty-two casks of quicklime, the stench being at the time so excessive as to cause several laborers to vomit. On the 25th and 26th of the month, St. Paul's churchyard, and the vaults of the North Dutch church, in William Street, received the same treatment, these being likewise very offensive and foci of epidemics.

The city of Boston, in 1850, passed an ordinance, providing that no graves should be dug in any burying-ground of the city, except at East or South Boston, unless by permission. It was also required that no grave should be less than three feet deep from the surface of the ground to the top of the coffin. Copp's Hill cemetery was, at this time, overcrowded, and the tombs were filled to the very threshold.

At Chicago, the old cemetery within the city has been discontinued for public burials since 1864; but private burials there still continue. Dr. Rauch, in a pamphlet published in

1866,* maintained that this cemetery, placed near the shore, contributed to the contamination of the water-supply of the city. The completion of the lake tunnel, however, must completely remedy this evil.

During epidemics of yellow fever and cholera, the pernicious influence of intra-mural interments in this country has been the most striking. Several instances are cited by Dr. Rauch. One of these was the epidemic at New Orleans in 1853, concerning which Dr. E. H. Barton reported that, in the fourth district, the mortality was 452 per thousand, more than double that of any other. In this district existed three extensive cemeteries, in which were buried, the previous year, more than three thousand bodies. In other districts, the proximity of cemeteries seemed to aggravate the disease. The Sanitary Commission unanimously recommended that "the present cemeteries, within the city limits, should all be closed against future use." This recommendation has never been complied with, however, the old system still prevailing of burying in tombs above the surface of the ground, in graveyards in the midst of the city, only sequestered by high brick walls.

Another instance was the epidemic at Norfolk and Portsmouth, in 1855, reported by Dr. Bryant. Here forty-five per cent. of the population died. Nearly all interments were made in the city, where the water-level is only six feet below the surface. The average depth of graves was about four feet, and, in many of them, three bodies were placed one upon the other. These cemeteries were considered by Dr. Bryant a fruitful source of disease.

A third instance was observed by Dr. Rauch himself, during the epidemic of cholera in Burlington, Iowa, in 1850. No deaths occurred in the neighborhood of the city cemetery until about twenty interments had been made there, and then cases began to occur, and always in the direction from the cemetery in which the wind blew.

Throughout the United States, large and attractive rural cemeteries have very generally superseded the old graveyards within city limits. Of these, Mount Auburn was the first, having been established in 1831. Laurel Hill was opened

* Intra-mural Interments in Populous Cities. Chicago, 1866.

soon after, and Greenwood in 1842. Within a few years, Chicago has acquired three rural cemeteries, and the number of such, in all parts of the Union, is rapidly multiplying.

England has been behind every other country in recognizing the evil of intra-mural interments and in applying the remedy. This is still more remarkable, in view of the fact that one of the earliest, if not the very first, published protest against burial in cities emanated from an English pen, being an anonymous pamphlet published in London in 1721, and entitled, "Seasonable Considerations on the Indecent and Dangerous Custom of Burying in Churches and Churchyards." This was prior to both the German and the French agitation of the subject, and led to no practical result at the time, unless, indeed, it may have led the way to the abolition of intra-mural interments in Dublin, which occurred in 1740. At that time a fatal epidemic of fever was distinctly traced to exhalations from the churchyards, and these were ordered to be removed out of the city. But this case was an isolated one.

The plan of Sir Christopher Wren for the rebuilding of London proposed to exclude all dark, narrow alleys and courts, and provided that not only "all churchyards," but "all trades that use great fires or yield noisome smells be placed out of town." This plan was not adopted.

But finally the condition of churchyards in London became so bad, that further neglect was impossible. In 1839, Mr. George A. Walker, a London surgeon, published a volume entitled, "Gatherings from Graveyards, especially those of London." This volume excited so much interest, that at last Parliament was induced to appoint a committee, who, in their report, dated June 14, 1842, demonstrated the great evils of intra-mural interment, quoted the testimony of medical men, and recommended a law forbidding the interment of bodies within the city, except in a few specified cases. The condition of the London cemeteries was, in this report, very thoroughly exposed. Public graves were dug, to contain thirty or forty bodies, piled to within a foot or two of the surface, and left open until full; in digging graves, great quantities of bones were exhumed, which were thrown together in a common vault; the soil was saturated with putrid

fluids, and exhaled the most offensive odors. It was the general testimony of physicians that typhus and other fevers were especially prevalent in the immediate vicinity of these grounds.

Notwithstanding the convincing nature of this report, it was eight years before any action was taken.

In 1843, Edwin Chadwick presented to the Home Department "A Supplementary Report on the Results of a Special Inquiry into the Practice of Interment in Towns." The report was printed and extensively distributed by the government throughout the kingdom. It constitutes probably the best work extant upon the subject of intra-mural sepulture, containing a remarkable mass of information concerning burial-places, both in England and in other countries.

In regard to the effect of burial-grounds upon well-water, he quotes Professor Brande as stating that he has "frequently found the well-water of London contaminated by organic matters and ammoniacal salts," and as referring to one instance of a well near a churchyard, "the water of which had not only acquired odor but color from the soil." Professor Brande also stated that "very many of these wells are adjacent to churchyards, the accumulating soil of which has been so heaped up by the succession of dead bodies and coffins, and the products of their decomposition, as to form a filtering apparatus by which all superficial springs must of course be more or less affected"; but he admitted the difficulty of distinguishing, by chemical analysis, whether contamination of water is due to cesspools, cemeteries or leakage from gas-pipes.

The condition of the London graveyards is thus described: "In the metropolis, on spaces of ground which do not exceed 203 acres, closely surrounded by the abodes of the living, layer upon layer, each consisting of a population numerically equivalent to a large army of 20,000 adults, and nearly 30,000 youths and children, is every year imperfectly interred. Within the period of the existence of the present generation, upwards of a million of dead must have been interred in these same spaces."

Chadwick deduces from the sum of the evidence upon the subject the conclusion, "that, inasmuch as there appear to be

no cases in which the emanations from human remains in an advanced stage of decomposition are not of a deleterious nature, so there is no case in which the liability to danger should be incurred, either by interment or by entombment in vaults, which is the most dangerous, amidst the dwellings of the living,—it being established, as a general conclusion, in respect to the physical circumstances of interment, from which no adequate grounds of exception have been established, that all interments in towns, where bodies decompose, contribute to the mass of atmospheric impurity, which is injurious to the public health.”

In 1845, was formed “The National Society for the Abolition of Burial in Towns.” The address of the society stated that “it may be demonstrated that an acre of earth is capable of affording decent interment every year to one hundred and thirty-six bodies, or thereabouts. In many of the parochial and other burial-grounds, each acre of land is compelled to receive annually more than one thousand bodies; some even two or three thousand, every year.” The address called for “a decided expression of public opinion,” and was distributed, in circular form, throughout the kingdom.

In 1850, a “Report on a General Scheme for Extra-mural Sepulture” was presented to both houses of Parliament by Carlisle, Ashley, Edwin Chadwick and T. Southwood Smith, showing the results of investigations made during the prevalence of cholera in London, when the pernicious influence of the graveyards was more than ever apparent.

Dr. Sutherland testified that he had witnessed several outbreaks of cholera in the vicinity of graveyards, which left no doubt on his mind as to the connection between the disease and such local influences; and that it is only when some epidemic comes that the consequence of long antecedent neglect becomes so apparent as to rivet attention and excite alarm.

The report contains an account of a large number of London churchyards, and also of the vaults of the various churches, showing their bad condition, and the remarkable prevalence and virulence of the cholera in their vicinity.

In the following year,—namely, in April, 1851,—still another report was made to Parliament, entitled “Report on

a General Scheme of Extra-mural Sepulture for Country Towns," signed by Carlisle, Ashley and Southwood Smith, in which this statement is made :—

"From these inquiries, it appears that, in country towns in general, small and confined spaces of ground have been used for burial, for centuries; that interments, in undiminished and even increasing numbers, continue to be made in these grounds long after they have been declared, by competent authorities, to be not only full but overcrowded; that commonly these burial-grounds are in the midst of the habitations of the living, and often are closely surrounded by dense populations, and that the exhalations arising from them are prejudicial to the public health."

The effect of these several reports was so convincing, that a change was at last brought about by legislative enactments.*

III. INTERMENT AT THE PRESENT DAY.

At the present day, the condition of the cemeteries of Europe and America is, as a rule, far different from that which has been described as formerly existing. Cemeteries are generally without the limits of towns, and more spacious than formerly. Care is also taken to select high ground and a porous soil; and, where it is necessary to make use of a clay soil, it is customary in England to underdrain it to the depth of eight feet. Regulations have been adopted as to the depth of graves, distance from dwellings and wells, etc. The depth of graves prescribed by law in France is from 4 feet 10 inches to 6 feet; in Munich, 6 feet 7 inches; in Frankfort, 5 feet 7 inches; in Stuttgart, for persons under eight years of age, 3 feet 9 inches; eight to ten years, 4 feet 7 inches; ten to fourteen years, 5 feet 7 inches; and upwards, 6 feet 7 inches. In this country the depth varies from 4 to 6 feet. The space allowed to each grave is, in England, four superficial yards, and about the same at Stuttgart and Munich; in Wurtemberg it is 54 feet, and in some parts of Austria, 90 feet. In England, it is customary to allow a quarter of an acre of ground to each 1,000 inhabitants.

* See Report of Royal Sanitary Commission, 1871. Abstract of English Laws relative to Burials.

In Italy, no well is allowed to be sunk within one hundred yards of any cemetery, and double this distance is required in France and Austria. This is called the "protective distance," but has, in some cases, been thought to be too small. The Hygienic Council at Brussels, in 1852, decided that a distance of four hundred yards was protective; but even this distance has been sometimes conceived to be inadequate. In Prussia, no cemetery may be located within five hundred paces of any dwelling. At Stralsund, in Prussia, the distance required is one thousand paces.

At Frankfort and Munich, in addition to the strict rules regarding burial, houses of reception have been made use of since 1829, as safeguards against premature burial, the bodies, while lying in them, being subjected to frequent inspections, and also connected with wires, so that the slightest movement will ring an alarm-bell. No body can be removed for burial without a physician's certificate that decomposition has commenced.

In England, the following "Regulations for Burial-grounds" are now in force:—

1. The burial-ground shall be effectually fenced, and, if necessary, underdrained to such a depth as will prevent water remaining in any grave or vault.

2. The area to be used for graves shall be divided into grave-spaces, to be designated by convenient marks, so that the position of each may be readily determined, and a corresponding plan kept on which each grave-space shall be shown.

3. The grave-spaces for the burial of persons above 12 years of age shall be at least 9 feet by 4 feet, and those for the burial of children under 12 years of age, 6 feet by 3 feet, or, if preferred, half the measurement of the adult grave-spaces, namely, $4\frac{1}{2}$ feet by 4 feet.

4. A register of graves shall be kept, in which the name, age and date of burial in each shall be duly registered.

5. No body shall be buried in any vault or walled grave, unless the coffin be separately entombed in an air-tight manner; that is, by properly-cemented stone or brick work, which shall never be disturbed.

6. One body only shall be buried in a grave at one time, unless the bodies be those of members of the same family.

7. No unwall'd grave shall be reopened within fourteen years after the burial of a person above twelve years of age, unless to bury another member of the same family, in which case a layer of earth not less than one foot thick shall be left undisturbed above the previously-buried coffin; but if, on reopening any grave, the soil be found to be offensive, such soil shall not be disturbed; and in no case shall human remains be removed from the grave.

8. No coffin shall be buried in any unwall'd grave within four feet of the ordinary level of the ground, unless it contain the body of a child under twelve years, when it shall not be less than three feet below that level.

The English burial-grounds are under the general supervision of a superintendent of burials.

In this country, the regulations are generally less explicit. In Massachusetts, burial-grounds may be regulated by boards of health.*

By the last annual report of Mt. Auburn cemetery, it appears that, up to the 31st of December, 1873, there had been made 18,646 interments, or about 177 per acre of the portion in use. These bodies have been accumulating during a space of 43 years. Last year, there were 513 interments, or about five per acre. This is a very different state of things from that which existed in the parochial grounds of London, thirty years ago. A dozen of the most crowded of these averaged from 1,204 to 2,323 per acre.

From what has preceded, it is evident that a great change has taken place, during the last century, in the burial customs of civilized nations. Intra-mural interments have been very generally abolished, and cemeteries are managed with a view to the public health. In searching for cases of recent date of disease resulting from graveyard infection, we find that such are almost unknown to medical literature. The only marked European case which we have yet discovered, is that mentioned by Pietra Santa, of the villages of Rotendella and Bollita, in Italy. The cemeteries of these villages were at the summit of a wooded hill at a considerable distance from the houses. The springs from which water was obtained were at the foot of the hill, and ultimately the

* General Statutes, chap. 28, §§ 4-11.

water became highly contaminated. A severe epidemic, which recently visited these villages, was ascribed to the use of this impure water. A similar case occurred during the past year, in Barbary, as an incident of the plague which has recently visited that country. The people of a certain village lived in excavations in rocks, getting their water-supply from wells into which water had run from the cemetery where bodies were covered only a foot deep with gravel. Those only who drank of this impure water were attacked with the plague.*

In April and May, 1874, there was an unusual amount of sickness, including cases of scarlet fever and diarrhœa, in the neighborhood of the Battersea cemetery, in London; and this was popularly attributed to the overcrowded, and, therefore, insanitary, condition of the burial-ground, although the relation of cause and effect cannot be considered as proved. It does not appear whether or not wells were used in this vicinity.†

While reported cases of disease presumably dependent upon the nuisance of graveyards are extremely rare, cases where water has been known to be polluted from this source, even though its use was followed by no ill-results, are scarcely less so. The following examples of such pollution have, however, been recently reported.

Pietra Santa‡ is responsible for the statement that, at the meeting held at Milan on the 6th of April last, Dr. Polli, to prove that inhumation taints air and water, referred to certain researches of Prof. Selmi, of Mantua, and to the chemical analyses of the waters of Milan by Profs. Parvesi and Rontondi.

Mr. Eassie§ states that M. Ducamp discovered in Paris, not long ago, a well, the water of which, entirely derived from cemeteries, had acquired a sulphur-like taste, so that people purchased it as mineral water!

Reclam|| furnishes the following case: "In the last remarkable report of the Faculty of Medicine of Saxe, Reinhard

* "British Med. Journal," August 22, 1874.

† "Med. Times and Gazette," November 21, 1874, p. 579.

‡ "Annales d'Hygiène Publique," July, 1874.

§ "British Med. Journal," August 1, 1874.

|| "Gaz. Méd. de Paris," May 23 1874. Translated in "Chicago Med. Ex.," August 1, 1874.

relates that nine large and several smaller victims of the cattle-plague were interred at Dresden, at a depth of ten or twelve feet. It was found, the next year, that the water from a well situate one hundred feet from the pit in which they were buried had a fetid odor and contained butyrate of lime. At a distance of twenty feet, it had the disgusting taste of butyric acid, and each quart contained about thirty grains of this substance. The bodies were subsequently disinterred and burned."

An example of air contaminated by a cemetery may be found, according to the daily papers of recent date, in Greenwood cemetery, which is said to have become, from this cause, a nuisance to the inhabitants of South Brooklyn.

Mr. Eassie* relates a case in which a cemetery became a public nuisance by the bursting of a reservoir at Herrenlauersitz, in 1854. The cemetery was thus washed away, and upwards of one hundred bodies were floated into gardens, houses and harvest-fields, whence they were not wholly removed until a fortnight after.

The only extended and minute investigations of water from wells situated in or near cemeteries that have been published, are, so far as we are aware, those of Prof. Fleck,† of Dresden. That city possesses ten cemeteries, two within the city, the others on the outskirts. Water from wells situated in nine of these was carefully analyzed by Prof. Fleck, between June and November, 1872, with the results shown in the annexed table.

* Loc. cit.

† Jahresbericht der chemischen Centralstelle für öffentliche Gesundheitspflege, in Dresden, 1873, p. 49. Investigation into the condition of the well-water in the Cemeteries of Dresden. For a translation of this paper, we are indebted to Prof. W. R. Nichols, of the Mass. Institute of Technology.

TABLE I.—*Fleck's Examinations of Well-water from Dresden Cemeteries.*

Number.	Parts per 100,000.	Residue from Evaporation.	Reduced silver.	Ammonia.	Lime.	Magnesia.	Nitric acid.	Sulphuric acid.	Chlorine.	Carbonic acid by volume.	Depth of well, in meters.	Height of water, in meters.	Temperature of water.*	Nearest grave, distant, in meters.	When last used.	Newest grave, distant, in meters.	Newest grave, when used.
1	Trinity Cemetery, .	27.38	.40	.080	7.26	1.14	3.30	6.42	1.41	—	8.0	1.00	9.9	2.1	1867	4	1869
2	" " .	28.34	1.92	.065	6.92	1.59	3.90	4.51	.95	—	9.7	1.00	10.0	1.4	1869	—	—
3	" " .	33.96	.60	—	6.92	1.80	4.20	6.55	1.42	—	9.7	1.00	9.9	2.0	?	—	—
4	" " .	28.86	1.40	—	7.20	1.60	2.60	5.38	1.13	—	10.65	2.00	10.0	1.5	1871	—	—
5	Trinity Cemetery, near the dwelling-house, .	33.44	1.04	—	6.42	2.05	5.10	7.65	1.40	—	8.5	1.30	10.8	10-12	1861-64	+	—
6	Elias Cemetery, .	89.73	.94	—	16.95	4.44	20.25	15.35	6.35	—	6.7	1.20	10.0	1.6	1860	10	1868
7	Anna Cemetery, .	37.83	4.63	.055	13.51	1.80	3.00	4.10	1.92	76.6	16.5	3.00	10.8	6.0	1858	10	1868
8	Anna Cemetery, near the grave-digger's house, .	65.47	3.87	.067	21.63	2.67	12.06	19.33	3.11	97.8	14.5	3.00	10.5	2.5	1872	—	—
9	Anna Cemetery, .	52.57	4.91	—	18.65	1.08	8.22	10.33	1.69	75.2	—	—	10.5	1.5	1847	3	1856
10	Old Anna Cemetery, .	87.27	6.22	.090	17.25	4.97	17.20	22.67	7.52	103.2	—	—	10.5	2.5	1870	—	—
11	Catholic Cemetery, in {	70.50	5.19	.075	12.58	3.81	19.02	15.52	7.47	59.7	8.6	2.00	11.0	2.5	1865	3	1871
12	Friedrichstadt, .	73.73	4.25	.101	13.93	3.70	19.02	16.55	6.21	66.5	7.5	2.00	10.5	3.0	1860	—	1868
13	Evangelical Cemetery, .	70.00	5.47	.057	11.50	4.26	18.82	16.95	5.87	54.3	7.6	1.30	10.5	3.0	1855-62	6	1871
14	New Friedrichstadt Cemetery, .	34.40	5.09	.100	9.86	2.10	8.70	9.91	2.20	43.3	9.0	0.93	10.5	1.0	1869	3	1871
15	" " .	44.70	5.40	.139	11.43	3.72	7.10	12.12	2.40	16.0	8.8	1.00	10.0	4.0	1872	—	—
16	Neustadt Cemetery, .	43.10	5.38	.092	8.49	2.87	11.20	10.51	1.99	24.5	8.0	1.00	9.0	1.0	1846	3	1869
17	" " .	37.30	5.34	.092	7.28	2.45	9.90	6.72	3.01	37.0	7.2	1.30	9.7	1.5	1854	2, 5, 3	1871
18	" " .	34.20	5.84	.123	7.26	2.46	8.70	9.66	1.79	32.1	14.1	1.00	9.5	30.0	1866	—	—
19	Heller Cemetery, .	7.70	4.87	.115	.62	—	.20	—	—	—	13.75	1.30	9.0	2.5	1869	—	—
20	" " .	11.20	5.62	.192	2.44	—	.10	—	.10	60.5	—	—	9.5	1.0	1864	—	—
21	" " .	9.90	5.34	.123	1.54	—	.10	—	—	48.2	—	—	9.5	—	—	—	—
22	" " .	25.80	5.09	.108	4.54	—	14.10	—	.41	38.3	9.3	1.30	10.0	18.0	1866-71	—	—

* In degrees (centigrade) above zero.

† Twenty-two meters outside the Cemetery.

Concerning these analyses, Prof. Fleck remarks as follows :—

“In general, there is little agreement in composition among the well-waters from the different cemeteries in Dresden, and it seems evident that the greatest influence is exerted, not by the proximity and age of the graves so much as by the character of the ground. With the exception of the water from the Trinity and the Elias cemeteries (in which cases the wells are situated in clean coarse gravel), the amount of organic matter is very considerable. This is the case to a marked degree in the well-waters of the oldest cemeteries,—the Anna cemetery (Annenkirchhof), the Catholic cemetery in the Friedrichstadt, and the old Evangelical cemetery,—where, besides notable quantities of nitrates, there was found a very considerable amount of unoxidized organic matter. In the Heller cemetery, which lies in clean sand on the right bank of the Elbe, the amount of nitric acid is very small; but the amount of ammonia and that of organic matter are quite large. These differences can be explained only by taking into account, in addition to the influence exerted by the character of the soil, also the effect of the ground-water itself. A ground-water at a great depth, moving slowly, that is to say, flowing with a slight fall, will dilute the matter dissolved from the soil less, and will afford a concentrated solution containing a larger proportion of organic matter than a ground-water flowing rapidly; and since, in the Trinity cemetery, the ground slopes somewhat rapidly towards the Elbe, we may infer that the motion of the ground-water is also somewhat rapid. This condition of things gives us as a product a water which is poor in decomposed and undecomposed organic matter; that is to say, a nearly pure water in spite of the greater amount of lime salts originally contained in the ground-water. In no other one of the cemeteries are the conditions so favorable as in the Trinity; and in the case of the Anna cemetery (Annenkirchhof), where we should expect a rapidly moving ground-water on account of the declivity of the surface, there is lacking, in the neighborhood of the wells, the porous material necessary to bring about a rapid decomposition of the contents of the graves.

“Further investigations of the waters of the Dresden cemeteries are projected for the year 1873. Meantime, however, it may even now be stated as the result of experience, that the best locality for a cemetery is on a porous, coarse-grained, gravelly soil, with rapidly moving ground-water; that is to say, situated on a declivity. In such a situation, the processes of decay go on rapidly, and consequently it is possible to renew the graves in a comparatively short time.

Of injurious physiological effects arising from the use of the water of the cemeteries of Dresden, there is no proof, as far as the author's knowledge extends. Moreover, it should, on the other hand, be mentioned that in each cemetery the well which is situated nearest to the grave-digger's house is used without regard to its quality by the grave-digger and his family, and up to the present time there has been no cause whatever for forbidding the use of the well.

“But, indeed, the composition of the cemetery-water does not differ essentially from that of the average well-waters of Dresden in respect to the decomposing organic matter, as may be seen by comparing with the above results the following determinations of the character of the water from various wells within the city :—

Number.	To 100,000 PARTS,	Solid residue.	Reduced silver.	Nitric acid.	Ammonia.
1	} Right bank of Elbe, . . . }	31.4	9.7	6.0	—
2		11.9	6.2	—	—
3		38.4	6.4	23.4	—
4		12.0	13.6	1.9	.20
5		12.5	9.4	2.5	—
6		28.2	4.4	1.8	—
7		91.4	6.4	18.6	.12
8		105.4	6.5	23.3	.14
9	} Left bank, }	82.6	3.2	19.4	.06
10		67.7	6.0	17.2	—
11		140.9	20.4	22.7	—
12		28.3	7.6	25.0	—
13		40.2	4.9	10.4	.05
14		80.3	11.2	13.3	—
15		89.6	6.4	25.0	—
16		31.9	10.8	6.9	.17
17		60.0	15.8	14.8	.20

The analyses were repeated in 1873 with very similar results; and, from the result of the two years' investigations, Fleck draws the following deductions:—

“That neither the period of interment nor the closeness of the graves directly exerted a marked influence upon the contents of wells, is proved by the fact that while in the water of the wells lying nearest to the graves little or no decomposed material was found, this appeared most abundant in the water of the well outside of the Trinity churchyard.

“The proportions of nitric acid and ammonia have remained very nearly the same during the past two years in the wells of nearly all of the Dresden churchyards; and it is ascertained that the wells of the oldest and of those which, being nearest the dwelling of the grave-digger, are most liable to be contaminated with house refuse, contain the largest proportion of nitric acid. Nevertheless the abundance of this ingredient, although amounting in the two oldest of the churchyards to between 0.188 and 0.190 gramme per litre, is surpassed by the amount contained in other wells of Dresden. The following table shows the results of the analyses of such wells in October, 1872:—

Well of Botanic Garden,	0.189 gramme nitric acid.
“ “ Wienerstrasse,	No. 23—0.227 “ “ “
“ “ Struvestrasse,	“ 15—0.233 “ “ “
“ “ Forststrasse,	“ 15—0.234 “ “ “
“ “ Dippoldiswalder Gasse, “	1—0.250 “ “ “
“ “ Ziegelstrasse,	“ 20—0.250 “ “ “

“This fact, which is of great importance in determining the influence of churchyards upon their surroundings, should not be too lightly considered.

"It is therefore established that the nitric acid in well-water is produced by the decay of the organic and nitrogenous elements of the soil; and, moreover, the proportion of nitric acid contained justifies the conclusion that the more nitric acid the water contains, the more soluble organic materials are there in the earth. The results, then, of the observations of churchyard wells prove that either the soil of the oldest churchyards yields to rain-water but little soluble organic material, or that the process of decay proceeds so slowly that from a cesspool, or badly constructed house-vault, as well as from sewers and drains, more organic decomposing and putrefying material is, in the course of a year, conveyed to the ground-water than from the graves of the most crowded churchyard."

With a view of ascertaining the experience of the medical profession as to the influence of cemeteries, as at present managed, upon the public health, a circular containing several questions has, during the past summer, been addressed to nearly five hundred physicians.

These circulars were sent to three hundred regular correspondents of the State Board of Health, one in each city and town of Massachusetts, to forty physicians of Boston, to forty of New York, to about seventy scattered throughout the United States, and to thirty in England, Scotland and Ireland. Such physicians were selected for correspondents as were supposed to take some special interest in sanitary subjects.

To these circulars, one hundred and seventy-one answers have been received; namely, one hundred and thirty-three from this State, thirty-two from other States, and six from England and Ireland.*

An analysis of the answers has been made, with the following results:—

QUESTION I.—*Have you observed any instances in which sickness appeared to be induced or aggravated by the proximity of dwellings to cemeteries? If so, please cite cases.*

The answers are as follows:

	Mass.	Other States.	Eng. and Ireland.
Yes, . . .	5	3	3
No, . . .	126	29	1
No reply, . . .	2	—	2
	<hr/> 133	<hr/> 32	<hr/> 6

* A few others were received too late to be included in this analysis.

QUESTION II.—*In such cases, have you attributed such sickness to poisoned wells or foul air, or both?*

Answers :—Air,	3
Water,	4
Both,	4
Total,	<hr/> 11

It is evident that the second question can be answered only by those who reply to the first in the affirmative.

Of the one hundred and seventy-one correspondents who reply to these circulars, therefore, eleven have observed sickness resulting from this cause; three attributing it to foul air, four to poisoned wells, and four to both causes combined. The remaining one hundred and sixty-one have never observed any such phenomena. Of the three hundred correspondents who have made no reply, it may be assumed that the fact of their not answering is, to a certain extent, an indication that cases of this kind have not come under their notice.

Affirmative answers were received from the five following towns in Massachusetts :—

1. *Wakefield*.—Yes; some years ago. Old Marine Hospital burying-ground. Foul air.

2. *Groveland*.—(Referred to later.)

3. *Lenox*.—1. In a few houses in the immediate vicinity of the Lenox cemetery, I have known of more sickness than in any other part of the village. These houses are all well-built and well-ventilated. The ground on which they stand is better drained than some other parts of the village, and I have not known of any accumulation of refuse near any of them; but they are near the foot of the hill on which the cemetery is located; the bottoms of the graves are on a much higher plane than the bases of the houses, and the natural drainage of the cemetery is in their direction.

2. I attribute the sickness in most of these cases, and in some others, to poisoned wells rather than to foul air. It is very possible, however, that the same water which poisons the wells may, in percolating through the soil, give rise to malarious emanations.

4. *Canton*.—In one case, seen years ago, fevers were apparently caused by the relative position of a well and a private burial-place; but the removal of families prevents the obtaining of facts.

5. *North Prescott*.—(Referred to later.)

From outside of Massachusetts, we have four answers in the affirmative.

6. DR. HENRY B. BAKER, *Secretary Michigan State Board of Health, Lansing, Mich.*—In examining into a case of cerebro-spinal meningitis, I found a village on the site of an old Indian burial-ground, and a present cemetery within village limits. Analysis of the well and spring water, by Prof. Kedzie, revealed evidences of contamination with organic remains. It is possible that the water had something to do with the epidemic.

9. DR. JAMES HENRY KENNET, *London, Eng.*—1. Twenty-four years ago I conducted an investigation into the health-influence of a crowded London cemetery on the surrounding population. It was the cemetery of St. George's Parish, Hanover Square, situated on one side of Hyde Park, originally in the country, but now surrounded by houses. The information then obtained, by house-to-house visitation, led me and a committee of medical men to conclude that the proximity of this cemetery was most detrimental to the health and well-being of the surrounding neighborhood.

Our report was drawn up in conformity with this conclusion and presented to the proper authorities. It led to the closing of the cemetery within a few months, and no doubt contributed, as far as it went, to decide the general question of intra-mural interment. As you are probably aware, such interment has not been allowed for many years in London.

2. In the above case, as there were no wells in use, to my knowledge, the unfavorable influence to health must have been owing to the escape, from the earth, of the gases of putrefaction.

10. DR. CHARLES A. CAMERON, *Professor of Hygiene, and Analyst to the City of Dublin.*—1. I have known one or two cases where illness was undoubtedly produced by the unwholesome emanations from a graveyard. This cemetery (the Abbey graveyard) is situated in the central part of the town of Dundalk, Ireland, and is surrounded by houses; the odor from it is most offensive, and the coffins in some parts are within eighteen inches of the surface. I have no doubt this place is the source of no inconsiderable amount of disease; in one case, I have known it to produce serious disease; but it is, of course, very difficult to be able positively to connect a case of illness with the bad condition of a cemetery situated near the patient. When we find a badly-kept cemetery, all we can assert is, that on general principles it must be more or less inimical to health and life.

2. On three occasions, I found well-water injuriously affected by the drainage from graveyards; in one of those instances, the well was within two feet of the graveyard.

The composition of one of those tainted waters was as follows:—

100,000 parts contained:—		
Solid matters,		76.560 parts.
Including	{ Albuminoid nitrogen,	0.085 "
	{ Ammonia,	0.076 "
	{ Nitrous acid,	1.265 "
	{ Nitric acid,	3.700 "
	{ Chlorine,	4.180 "

I am disposed to believe that the injuries arising from badly-kept graveyards are to be attributed to a far greater extent to the foul air than the

contaminated water. If the latter be very foul, it will, of course, produce diarrhœa, lowering of the vital powers, and other effects caused by water containing simple decomposing organic matter; but I am of opinion that the water tainted by graveyards does not cause typhoid fever or other zymotic disease. These maladies are each of them produced by the introduction of living poisons into the body, and these poisons are thrown out of the bodies of the sick. Sewage-contaminated water and air are the carriers of typhoid and cholera.

PHILIP H. HOLLAND, M. R. C. S., *Medical Inspector of Burials of England and Wales*.—If by the term cemeteries is meant what are popularly so called in England, namely, large urban or suburban burial-grounds, which may be fairly described as small parks or large gardens,—used also as places of sepulture,—in which regulations,* such as those enclosed, or others practically equivalent to them, are observed, I reply that I have never known of any instance of sickness which appeared to be induced or aggravated by any such cemetery, of ample size for its burials, well situated and well managed. If by cemeteries it is intended to include those burial-grounds, the use of which, in England, is now nearly superseded,—small, overcrowded, in close situations, and in which soil was disturbed before the putrid matter in it was decayed,—I reply that I have no doubt that much mischief was done by them; but that such mischief was more frequently in depressing health than in causing actual disease, and that other causes of ill-health so frequently, so almost constantly co-existed, that it is difficult to decide how much of it was due to one particular cause.

The evil has arisen both from poisoned water and poisoned air; the most numerous cases I just now remember were from foul water soaking from or bailed out of graves, rendering the air offensive, and, in some cases, poisonous, producing vomiting and purging. Such cases have now become very rare, because of the great improvement effected under the burial acts.

Water draining from cemeteries very rarely does any mischief, because it is very rarely allowed to mix with that used for drinking, except, indeed, after it has first passed through such a thickness of soil as must insure the complete oxidation of any organic matter it may contain. The mere idea of drinking graveyard-soakage is so disgusting, that it is almost always carefully avoided, even when no actual danger from it need be feared; and it is very probable that greater care has been taken to avoid this danger than has been necessary; for such soakage, which has passed through only a moderate quantity of soil, is often found more free from putrescible matter than water which appears to be quite wholesome, and is certainly perfectly inoffensive. It is nevertheless prudent and right to require that the water directly draining from a cemetery shall not mingle with that used for drinking; though, in several of the few cases in which injury from it has been suspected, I have found that the pollution certainly proceeded chiefly from sewers or cesspools, while it was very doubtful whether any of it was derived from a graveyard. The commissioners for inquiring into the pollution of rivers inform me, in reply to my inquiry, that "the samples of water from a densely-crowded, and, in consequence, recently-closed, cemetery, which have been analyzed in the laboratory of this commission, show that whilst such drainage-water is utterly unfit for human consumption, it is but very moderately polluted by organic matter. It can be safely admitted into any river or stream, not used for domestic purposes, without the slightest un-

* See pp. 277 and 278.

pleasant consequence. It is very similar to land-drainage from heavily-manured fields."

Dr. Letheby and Dr. Tidy have both examined, at different times, the water in the drain from the large cemetery for the city of London (Ilford), which was, on both occasions, found to be perfectly inoffensive, and proved to be more free from putrescible matter than the little river into which it flowed, which received the washings from cultivated fields and meadows. Dr. Letheby found abundance of nitrates, but very little ammonia or decomposing organic matter. The specimen Dr. Tidy examined contained, per gallon,—

Ammonia—actual or saline,	0.01
Nitrates,	3.24

The soil is drift-sand and gravel.

It would, however, be a dangerous error to conclude, that because a well or stream near a source of contamination is free from it when examined, it is therefore a fit supply for drinking. The most striking case I ever met with of poisoning by polluted water was by that of a well which is generally pure, but which on one occasion received the overflow of a neighboring cesspool allowed to become overfull. The effect was, that out of twenty-six persons who had their water-supply from the well, sixteen had cholera or diarrhea within a few days, of whom nine died,—no fresh cases occurring after the cause was discovered and avoided. Cholera, though epidemic in England at the time, was not so in the village, in which there was only one other fatal case. There was no evidence or probability of contagion having been the cause.

We must confess to being greatly surprised at the small amount of evidence we have been able to gather of any positive injury known to result from burial-grounds. Of the five cases in this State, the first occurred "some years ago," and the fourth "years ago," and no particulars are given of either case. In the second case (Groveland), there is scarcely enough to hang a suspicion upon, especially as further investigation has shown the well to be 300 feet from the nearest grave, while the privy and barnyard are but 30 and 80 feet away, respectively. In the fifth case (North Prescott), the water has been found to be bad; but, since the nearest grave is 500 feet away, while there is a drain within less than 50 feet, and a privy and barnyard but little further removed, the contamination cannot fairly be attributed to the cemetery. Thus the third case (Lenox) is left as the only one in which there is a reasonable presumption that the cemetery may have caused injury to health. As the physician reporting the case has removed from the State, we have been unable to more thoroughly investigate it.

Of the cases not in this State, in Dr. Baker's, the influence of the graves was merely possible. Dr. Kennet, of London, refers to a crowded churchyard in that city, closed twenty-four years ago, at the time of the English burial reform; Dr. Cameron, of Dublin, reports one or two cases in Ireland, where the deleterious influence of graveyards was well established, and Mr. Holland, of London, than whom no person living can speak more authoritatively, says that he has never known any injury to result from any modern, well-managed cemetery, although he has from the old over-crowded burial-grounds, now nearly superseded. The two last-named authorities, although furnishing this evidence, are firm believers in the absolute harmlessness of burial, if properly performed.

Of the negative answers, the majority are monosyllabic. Of those which are more extended, a considerable number state that the cemeteries in their vicinity are at a distance from any dwellings. The following negative replies are selected as possessing some special interest:—

Bedford, Mass.—Believing profoundly in the expediency of abolishing the present repulsive method of disposing of the dead, and knowing from personal experience that a well twenty-two feet away from a privy, in a tolerably compact, gravelly soil, may be sensibly contaminated by percolation, I should be glad to bring some positive proof to fortify my strong conviction, but find myself quite unable to do so.

Cambridge, Mass.—I do not remember an instance in which I have had reason to believe that sickness was caused or aggravated by the proximity of dwellings to cemeteries. On the other hand, it may not perhaps be amiss to state, that I have known dwellings near to large cemeteries, in which persons have lived, children been born and reared, without evidence of injurious influences. Mt. Auburn cemetery, the Catholic cemetery, and the Cambridge city cemetery are quite near each other; the first two adjoining, and the other separated from these by a public road only. In Mt. Auburn alone, more than 19,000 interments have been made; in the other cemeteries, also, the numbers are large; but it is not known that new diseases have appeared in their vicinity, or that known diseases have been modified, or that they have injured the health of the neighborhood, or of the laborers constantly employed in them during the summer. Dwellings are within one hundred feet of the Catholic cemetery. The other Catholic cemetery at North Cambridge is crowded; in some instances several bodies in one grave. The cemetery is closely surrounded by houses fully inhabited, one house in the cemetery, but no injurious effects are known to me. There are several wells in Mt. Auburn. From that near the gate, many hundreds of visitors drink annually without known injury. There are interments within forty feet of another well, a favorite well with the workmen, and much used. A third well has a dis-

agreeable taste, and is used only for watering the grounds. The water has never, to my knowledge, been analyzed; it can easily be obtained. The drainage of the Catholic cemetery, above mentioned, at North Cambridge, was for many years into Fresh Pond meadow, and after the outlet of that meadow into Mystic River was cut off, the drainage of the meadow was into Fresh Pond itself. The water-supply for Cambridge is from this pond. No injurious effects from decaying matter have been proved, although much feared upon generally received sanitary views. Water in ponds from which water supplies are usually taken contains much living matter, fishes, reptiles, polyps, infusoria; indeed, if water from ponds contained no living animals it would be looked upon with suspicion, as probably injurious to animal life. But, if it contain living animals, it must also contain more or less dead animal matter, which in one instance was believed to have been in sufficient quantity to make Cochituate water oily and disagreeable to the taste.

Everett, Mass.—Have had many patients near Woodlawn cemetery. No typhoid, no dysentery, no more cholera infantum than elsewhere.

Lowell, Mass.—After careful inquiry here among the oldest residents and physicians, undertakers, employes in cemeteries and persons residing near the latter, and after some observations made in other places, from time to time, in the course of my life, I have failed to learn of any cases of sickness traceable to burying-grounds for their cause.

Malden, Mass.—I have practised medicine here for twenty-five years. Within the limits of the town, there are four or five burial-places. One of these is surrounded by dwelling-houses; several have a few residences in immediate proximity. I know of no evidence which goes to show that in these dwelling-houses sickness has been induced or aggravated in the manner referred to.

Middleton.—From a residence here of nearly forty years, and careful inquiry of those best informed on this subject, I am satisfied that the burial of the dead in this town has no unfavorable influence on the health of the living.

Orleans, Mass.—In this section of country, no cases of sickness of any kind have, to my knowledge, resulted from or been aggravated by the proximity of dwellings to cemeteries.

South Dennis.—Our parsonage is so situated that it takes all the drainage or washings of the cemetery, and for twenty-two years there has been very little sickness, and no one case that could be in any wise attributed to any poisonous influence arising from the cemetery. One case of typhoid fever and one of phthisis, both came to the parsonage after the disease had appeared and became established.

West Springfield.—I cannot find out that those living in the vicinity of the cemeteries have had any disease at all traceable to their situation.

Winthrop, Mass.—Although I have watched, with a good deal of interest, families residing near cemeteries, I have failed, thus far, to discover that it had any effect whatever upon the health of such families.

Dr. LIONEL S. BEALE, F. R. S., *London*.—I have not observed any cases, neither have I heard of any.

Dr. JAS. S. BAILEY, *Albany, N. Y.*—During an experience of more than twenty years in the practise of medicine, I cannot recall a single case of sickness attributable to such a cause, directly or indirectly.

The Albany Rural Cemetery contains 230 acres of land, and within the grounds there are already 20,000 human bodies laid.

Dr. J. S. BILLINGS, *Assistant-Surgeon, U. S. A., Washington, D. C.*—I know of no ill-effects from the very large military cemeteries around this city.

Dr. ROBERT REYBURN, *Washington, D. C.*—I lived for a number of years in Philadelphia within a block of a cemetery which was in constant use as a place of interment, and never remember to have seen a case of disease that could be fairly traced to that cause, though I practised extensively in the immediate vicinity. I can readily understand, however, that a cemetery densely filled in a crowded city may become a dangerous neighbor; but if it is thoroughly drained, and if the bodies are not buried within six feet of the surface of the ground, I do not believe there is any danger of its affecting the health of the neighborhood.

Dr. CHARLES M. ELLIS, *Member of State Board of Health, Elkton, Md.*—I have not observed any sickness to have been induced by the proximity of graveyards.

Dr. S. L. JEPSON, *Health Officer, Wheeling, W. Va.*—The following answers are given after consultation with six of our oldest and most respectable physicians, and may be accepted as our united opinions:—

1. No. 2. No.

Dr. MANNING SIMONS, *Charleston, S. C.*—For two years I was physician to a dispensary, which included two of the largest wards in the oldest part of the city of Charleston, and contained within its limits four cemeteries; but during that time I saw no cases of disease the origin of which I could trace to proximity to these localities.

Dr. W. DUNCAN, *Savannah, Ga.*—In order that you might have the views of our entire profession, I submitted your letter to our local society and requested that the subject should receive special consideration. In accordance with that request, the subject was thoroughly discussed and voted upon with the following result:—

First question: No—unanimous.

Second question: No—unanimous.

We will now pass to the consideration of the third question, which is intimately connected with the two which have preceded it.

QUESTION III.—*Water, believed to be contaminated with cemetery-washings, is desired for analysis. Could you, if requested, send a gallon of such water, with a full account of its source and the illness it has been supposed to produce?*

In response to this question, the evidences of water-contamination were so extremely small that the examination was not confined to these, but was extended to such waters as could be obtained from wells contiguous to graves, whether believed impure or not. The specimens (fifteen in number) were sent to the Massachusetts Institute of Technology, where the analysis was made by Prof. W. R. Nichols and Miss Ellen H. Swallow.

The samples examined are as follows :—

1 and 2. "From a well and brook respectively in Lindenwood cemetery, Stoneham. The former is constantly used for drinking purposes by visitors to the cemetery, and is generally considered pure. The brook is contaminated also by refuse from tanneries."

3. From a well in a cemetery at Lowell: "The water is used mostly for watering purposes, not commonly for drinking; not suspected of being impure or of causing any sickness. It tastes well and is almost clear."

4. From a well at Groveland, five hundred feet from a cemetery, and fifty from a privy, etc.

5. Well-water from a town in Hampden County: "Distance from the nearest grave two hundred feet. The water has been in constant use for twenty-nine years, and has not been suspected of causing disease, but is twenty-five feet from a privy, sink-spout and stable."

6. From a well in Hudson, Mass.: "At the extreme eastern end of a cemetery which slopes from west to east, with a number of graves of all ages in the immediate vicinity.

The water has been used for drinking purposes, but not for four years; has generally been considered pure. No other source of contamination in the vicinity."

7 and 8. From two wells closely adjoining a cemetery in Fitchburg. Neither has ever been considered impure or suspected of causing sickness; but this section of the city "has appeared more unhealthy than other parts, and within two or three years has seemed the centre of two epidemics of scarlet fever." "The cemetery is extremely unfavorably located. It is built on an elevated sandy knoll, bordered on two sides by streets, and quite a large population occupy these streets, and others close by, on land much lower down. There are also several reservoirs for the supply of water for domestic use almost under the hill, covered by the monuments of the dead."

"The first bottle was filled from a well under the very lowest corner of the cemetery; but the nearest recent interment I should judge to be a little more than one hundred feet. The other bottle was filled from a well in close proximity to the cemetery, but I believe there have been no recent interments within about two hundred feet; but the hill forming the burial-place of most of the dead rises quite abruptly to a considerable elevation. I am not aware that any cases of severe sickness have occurred in the families using the water of these wells."

9 and 10. From a spring and well in a cemetery in Canton: "The spring from which jar No. 1 was filled has a capacity of about ten gallons per minute, and is used for drinking purposes by visitors, laborers and a neighboring school of about eighty children. The soil in this vicinity is a coarse gravel. This being the newest part of the grounds, only about fifty graves have been made within a radius of one hundred and fifty feet. Jar No. 2 was filled from the well, which is, say four feet deep and two in diameter. Water from this well is delivered to about twelve families. Soil, coarse gravel. Nearest graves, one hundred feet distant and about ninety feet higher. There never has been any unusual sickness among those using the water from

either the spring or well; but, on the contrary, the people are very healthy."

11, 12, 13 and 14. From four wells situated near a cemetery at North Hadley. "The cemetery is located upon a narrow ridge, trending to the south, these wells being in that direction, and on the same general level, from 360 to 720 feet from the cemetery, and have privies and house-drains within 50 feet of them."

15. From a well in Middlesex County, thirty rods from the nearest grave, while barn-yard, privy and sink-drain are very near.

The following table shows at a glance the main facts in regard to location, etc., of these wells:—

TABLE II.—*Descriptive of Wells, etc.*

Number.	LOCATION.	Depth, feet.	Age, years.	Soil.	Distance from nearest grave, in feet.	Distance from nearest grave, in feet.	Whether used for drinking.	Whether suspected of causing sickness.	Other sources of contamination.	Remarks.
1	Stoneham, Well.	10	10	Gravelly.	60 ¹	60	Yes,	No,	None.	Water 2 ft. deep.
2	Stoneham, Brook,	—	—	—	—	—	—	—	Factories, tannery, etc.	—
3	Lowell, .	11½	15	Sandy.	50	50 ³	—	No,	None.	—
4	Groveland, .	12	100	Sandy.	300 ²	—	Yes,	Yes,	Barn-yard 80 ft. higher, privy 30 ft. lower, well close to house.	Water 3 ft. deep.
5	Hampden Co.,	17	29	Coarse sand,	200	4	Yes,	No,	Privy, sink-spout and stable 25 ft. distant.	Water 15 in. deep; believed impure.
6	Hudson, .	15	15	Gravel,	10	35 ⁵	—	No,	None.	Water 5 in. deep.
7	Fitchburg, .	—	—	—	—	100	Yes,	No,	Not stated.	—
8	Fitchburg, .	—	—	—	—	200	Yes,	No,	Not stated.	—
9	Canton, Spring,	—	—	Coarse gravel,	75	75 ⁶	Yes,	No,	None.	Graves much higher than well.
10	Canton, Well,	4	—	Coarse gravel,	100	—	Yes,	No,	None.	—
11	North Hadley,	20	30 to 40	Sandy,	360	—	Yes,	No,	{ Privies and drains within 50 ft.	Offensive to taste and smell.
12	North Hadley,	20	30 to 40	Sandy,	510	—	Yes,	No,		Offensive odor.
13	North Hadley,	20	30 to 40	Sandy,	720	—	Yes,	No,		
14	North Hadley,	20	30 to 40	Sandy,	660	—	Yes,	No,		
15	Middlesex Co.,	15	100	Hardpan,	495	545 ⁷	Yes,	No,	Drain less and barn-yard and privy more than 50 ft. distant.	

¹ Less than 60.² About.³ No interment for 1 year.⁴ No interment for 3 years.⁵ No interment for 25 years.⁶ Not commonly.⁷ No interment for 5½ months.⁸ Not for 4 years.

The following tables show the results of the analyses by Prof. Nichols and Miss Swallow. In the first, the results are expressed in parts per 100,000, and in the second, in grains per United States gallon. It will be observed that the column headed "reduced silver" in Fleck's table is omitted in these. This refers to a new method, proposed by Fleck, of determining organic impurities by the amount of silver which they will reduce. This method was applied in the analysis of all of these samples of water, but the results are considered by Prof. Nichols of such questionable value, that they have been omitted.

TABLE III.—*Examination of Water in the Vicinity of Graves in Massachusetts.*

[Results expressed in Parts per 100,000.]

Number.	Date.	LOCALITY.	Ammonia.	"Albuminoid Ammonia."	SOLID RESIDUE OF UNFILTERED WATER.			SOLID RESIDUE OF FILTERED WATER.			Chlorine.	Nitrogen as Nitrates and Nitrates.	Phosphates.
					Inorganic.	Organic and Volatile.	Total.	Inorganic.	Organic and Volatile.	Total.			
1	1874. Sept. 8,	Well in Lindenwood cemetery, Stoneham, . . .	.0040	.0110	2.92	.04	2.96	—	—	—	.84	Trace.	Trace.
2	8,	Brook running through Lindenwood cemetery, . . .	.0044	.0074	23.36	4.72	28.08	—	—	—	9.60	Trace.	Trace.
3	8,	Well in Lowell, . . .	.0051	.0047	3.84	1.36	5.20	—	—	—	.32	—	—
4	14,	Groveland, . . .	.0005	.0073	9.36	.64	10.00	—	—	—	.40	—	—
5	19,	Hampden Co., . . .	.0064	.0113	28.40	4.60	33.00	—	—	—	5.60	Trace.	Trace.
6	24,	Hudson, . . .	.9500*	.1500*	7.32	7.60	14.92	5.00	4.28	9.28	.70	§	Trace.
7	25,	Fitchburg, Mr. Damon's well, . . .	.0031	.0027	4.48	1.52	6.00	—	—	—	.28	+	Trace.
8	25,	Mr. Danby's well, . . .	.0020	.0023	4.20	1.00	5.20	—	—	—	.24	+	Trace.
9	29,	Canton, No. 1, . . .	.0027	.0040	4.12	.40	4.52	—	—	—	.44	+	Trace.
10	29,	No. 2, . . .	.0020	.0027	4.72	.48	5.20	—	—	—	.40	+	Trace.
11	Oct. 1,	No. Hadley, No. 1, F. Smith, . . .	.6840	.0620	122.40	16.20	138.60	—	—	—	13.20	Trace.	Trace.
12	1,	No. 2, E. Smith, . . .	.2660	.0380	24.80	7.40	32.20	—	—	—	3.20	+	Trace.
13	1,	No. 3, H. Smith, . . .	.4920	.0440	64.28	8.80	73.08	—	—	—	8.80	+	Trace.
14	1,	No. 4, A. Belden, . . .	.3380	.0180	38.82	10.80	49.12	—	—	—	7.60	Trace.	Trace.
15	12,	Middlesex Co., . . .	.0200	.0156	5.92	1.00	6.92	—	—	—	.40	Trace.	Trace.

* The filtered water gave .0456 "albuminoid ammonia."

† Considerable.

‡ Very small amount.

§ Large amount.

NOTE.—The qualitative tests for nitrates and phosphates were applied to the *unconcentrated* water.

TABLE III. a. *Examination of Water in the Vicinity of Graves in Massachusetts.*
[Results expressed in Grains per U. S. Gallon.]

Number.	Date.	LOCALITY.	Ammonia.	"Albuminoid ammonia."	SOLID RESIDUE OF UNFILTERED WATER.			SOLID RESIDUE OF FILTERED WATER.			Chlorine.	Nitrates and Nitrites.	Phosphates.
					Inorganic.	Organic and Volatile.	Total.	Inorganic.	Organic and Volatile.	Total.			
1	1874. Sept. 8,	Well in Lindenwood cemetery, Stoneham, Mass., .	.0024	.0064	1.70	.02	1.72	-	-	-	.49	Trace.	Trace.
2	8,	Brook running through Lindenwood cemetery, .	.0026	.0043	13.62	2.75	16.37	-	-	-	5.60	Trace.	Trace.
3	8,	Well in Lowell, .	.0030	.0027	2.24	.79	3.03	-	-	-	.19	-	-
4	14,	Groveland, .	.0003	.0043	5.46	.37	.583	-	-	-	.23	-	-
5	19,	Hampden Co., .	.0037	.0066	16.58	2.68	19.26	-	-	-	3.27	†	Trace.
6	24,	Hudson,*	.5545	.0875	4.27	4.47	8.71	2.92	2.50	5.42	.41	‡	Trace.
7	25,	Fitchburg, Mr. Damon's well, .	.0018	.0016	2.61	.89	3.50	-	-	-	.16	§	§
8	25,	Mr. Danby's well, .	.0012	.0019	2.45	.58	3.03	-	-	-	.14	§	-
9	29,	Canton, No. 1, .	.0016	.0023	2.40	.23	2.63	-	-	-	.26	§	-
10	29,	No. 2, .	.0012	.0016	2.76	.28	3.04	-	-	-	.23	-	-
11	Oct 1,	N. Hadley, No. 1, F. Smith, ¶	.3992	.0362	71.43	9.45	80.88	||	||	||	7.70	Trace.	Trace.
12	1,	No. 2, E. Smith, ¶	.1553	.0222	14.47	4.32	18.79	-	-	-	1.87	Faint traces.	Faint traces.
13	1,	No. 3, H. Smith, ¶	2.8720	.0257	37.52	5.14	42.66	-	-	-	5.14	Faint traces.	Faint traces.
14	1,	No. 4, A. Belden, ¶	.1973	.0105	22.37	6.30	28.67	-	-	-	4.44	Trace.	Trace.
15	12,	Middlesex Co., .	.0116	.0091	3.45	.58	4.03	-	-	-	.23	Trace.	Trace.

* Very turbid, one mass of animalcules under the microscope. Odor, when concentrated, very offensive.

† Considerable.

‡ Very small amount.

§ Very bad odor; much organic material.

¶ The appearance of these waters was not such as to cause a suspicion of their very bad quality. Nos. 1 and 3 had a little suspended matter which the microscope showed to be in a state of decomposition, very few vegetable organisms growing.

In order to afford a standard for comparison, the subjoined analysis of the Cochituate water at Boston, made July 4, 1873, is copied from Prof. Nichols' article on "The Present Condition of Certain Rivers of Massachusetts," in the Fifth Annual Report of the State Board of Health.

COMPONENT PARTS.	Parts per 100,000.	Grains per gallon.
Ammonia, . . . . .	.0033	.0019
"Albuminoid Ammonia," . . . . .	.0120	.0070
Inorganic,	2.8400	1.6600
Organic and Volatile,	2.8000	1.6300
Total dissolved matters,	5.6400	3.2900
Chlorine, . . . . .	.3400	.2000

We find, therefore, that the wells at Stoneham, Lowell and Groveland scarcely differ in purity from the Cochituate water; those at Fitchburg and Canton are more pure than this; that at Hudson and the one in Hampden County (No. 5) are impure; that in Middlesex County (No. 15) very slightly so; while the four wells at North Hadley are very impure. The brook at Stoneham, although containing but little ammonia and albuminoid ammonia, is very rich in chlorine. By referring to table No. II., it will be seen that all of the impure wells, with the single exception of that at Hudson, are at a great distance (200 to 720 feet) from the nearest grave, while they all, with the same exception, have privies, drains or barn-yards at distances of from 25 to 50 feet. The well at Hudson is 15 feet deep, in gravelly soil, only 10 feet from the nearest grave; the next nearest grave is 12 feet distant and six years old; the newest grave in the vicinity is 35 feet distant and five and a half months old (in September, 1874); the ground slopes towards the well, and there is no other possible source of contamination in the vicinity. The water has been considered pure, though not used for four years. Analysis shows it to be very rich in ammonia, albuminoid ammonia, inorganic and organic residue, but with very little chlorine. This well, therefore, is undoubtedly contaminated by the proximity of graves; but contamination from this source cannot, with any show of reason, be affirmed of any of

the others. Three of the purest wells, viz., Nos. 1, 3 and 9, are nearer to graves than any other, except that last mentioned, the distances being respectively 60, 50 and 75 feet.

If any deduction may be drawn from so limited a number of analyses, it is this: that wells in or near cemeteries (unless *very* near to graves, as in No. 6) enjoy an especial immunity from contamination, inasmuch as their position renders them less likely than others to be tainted by privies, drains and cesspools.

Fleck's examinations of Dresden wells have brought him to a similar conclusion, as may be seen by referring to the passages from his report, already quoted.

The evidence that a great amount of disease, especially typhoid fever, is induced by drinking-water polluted by drains, privies and cesspools, is constantly accumulating. It can be found in all of the previous reports of this Board, and all sanitary literature abounds with it. The number of cases of sickness, and even of death, occurring annually in Massachusetts from this cause is certainly enormous; and yet, after a diligent inquiry, we have been unsuccessful in obtaining a single example of disease presumably induced by water contaminated by the proximity of burial-grounds.

From the report upon "Sewerage," etc., by the late Dr. Derby and Prof. Nichols, in the Fourth Annual Report of the State Board of Health, we extract this foot-note to page 101.

"The following table shows the amount of impurity recently found in certain wells in eastern Massachusetts, by Mr. S. P. Sharples, who published the results in the 'American Chemist,' for Nov. 1872. It by no means represents the general character of our wells, but shows how bad they may become by intercepting the drainage of barn-yards, privies and other sources of filth. In the case of the well at Webster, it is stated that the water was sweet and pleasant to the taste; but the family using it had typhoid fever, and this circumstance led to the examination. The numbers represent grains in one United States gallon:—

LOCALITY.	Inorganic matter.	Organic and Volatile.	Total weight of Residue.
Newton,	14.12	6.53	20.65
Waltham,	17.79	7.46	25.25
Waltham,	4.66	7.60	12.26
Hyde Park,	13.12	7.98	21.10
Andover,	8.14	8.46	16.60
Taunton,	9.91	8.74	18.65
North Cambridge,	16.42	8.75	25.17
Woburn,	62.71	10.78	73.49
Newton,	19.25	13.41	32.66
Andover,	40.59	16.03	56.62
Webster,	15.81	29.00	44.81
Chelmsford,	47.25	29.16	76.41
Andover,	3.79	33.54	37.33

In these wells, the organic and volatile ingredients are in larger proportions than in any of those we have just been investigating, excepting the well at Hudson, and the four at North Hadley; while the very worst upon our list is surpassed in impurity by the last three upon Mr. Sharples' list.

In summing up this investigation, we cannot avoid the conclusion that, as far as it goes, it shows that any injurious influence exerted upon the public health by burial-grounds, as at present managed in this State, as well as throughout the United States, is almost unknown; and that this, compared with the ordinary causes of disease, which exist about every dwelling, is utterly insignificant. In other words, a living man in sound health is far more to be dreaded as a disease-producing agent, than is a dead man buried with ordinary care.

IV. MEDICAL OPINION OF BURIAL AND CREMATION.

The last two questions in our circular had for their object the obtaining of a somewhat general expression of opinion from the medical profession, concerning the adequacy of the present method of disposing of the dead, and of the need which may exist for the adoption of any other method. The questions are these:—

QUESTION IV.—*Do you consider interment the best method, in a sanitary point of view, of disposing of the dead?*

The answers may be classified as follows:

	Massachusetts.	Elsewhere.
Yes,	53	17
Yes, with precautions,	12	6
Yes, in the country,	21	—
No,	36	8
No opinion,	11	7
	<hr/> 133	<hr/> 38

QUESTION V.—*If not, please state your views concerning Cremation, or any other method which you may think superior.*

This somewhat indefinite request has received no less indefinite replies, and it is therefore not without considerable difficulty that they have been grouped, as in the following tabular statement:

	Massachusetts.	Elsewhere.
Approve,	36	11
Approve in cities,	13	1
Disapprove,	11	10
Prefer embalming,	3	—
Prefer chemical disintegration,	4	—
Prefer encasing in Portland cement,	1	—
No opinion,	65	16
	<hr/> 133	<hr/> 38

Although free from any personal bias in this inquiry, we cannot withhold the observation that the value of the opinions against interment, and of those in favor of cremation, is impaired by the fact that they are based on theoretical grounds, rather than personal knowledge. Thus we find that, of the forty-four who are dissatisfied with interment, only two have observed instances of sickness resulting from that method; the instances being years ago, in both cases.

Of the remaining nine who report having observed such cases of injury, seven express themselves in favor of adhering to the present custom, one thinks interment the best method, providing lime be strewn on the coffins, and one prefers burial for the country and embalming for the city. The disapproval of interment, therefore, grows out of a general impression that it is frequently harmful; and this impression doubtless results, in great part, from former reading of the reports upon the condition of the English churchyards, thirty years ago,—a state of things which no longer exists. The opinion in favor of cremation, expressed by sixty-one correspondents, is evidently based upon this general disapproval of interment, added to a scientific and æsthetic interest in the subject, induced largely by the recent agitation in its favor.

But we do not wish to disparage the opinions expressed by so large a number of professional gentlemen of the highest standing. The fact remains, that whether from hygienic or other reasons, more than a third of our correspondents have given their testimony in favor of the adoption of cremation as a substitute for burial. Some of these expressions of opinion will be presented.

DAVIS.—I do not consider interment, *as it is frequently practised in this country*, the best method, in a sanitary point of view, of disposing of the dead. Yet I think that, under proper regulations, it can be made perfectly safe. If graves are made deep, in a dry, porous soil, I think it probable that all noxious gases will be absorbed or chemically changed as fast as they are produced. In the hilly parts of the country, there are many cemeteries on steep hillsides, adjacent to and overlooking towns or villages, and many others in low and damp ground. In hillsides, underground springs are common, and the water from these, as well as from copious rains, must sometimes pass through graves in sufficient quantities to carry off gases in too great abundance to be immediately absorbed by the surrounding earth. I believe instances are not unknown of the complete excavation of graves by heavy rains. In low situations, during some seasons of the year, the ground is liable to be saturated with water already so impregnated with gases as to be incapable of receiving any more. Here, when a grave is dug, the water runs into it so fast that it is impossible to make it very deep, and in cemeteries so located it is not uncommon to bury the dead in graves already filled to a depth of several inches with mud and water. In such conditions, the gaseous products of the decomposition of the bodies, and the wood of the coffins and boxes, are given off rapidly, and not being readily absorbed by the moist earth, are largely exhaled therefrom. To such an extent did this occur in one part of the cemetery of Bloomfield, N. J., that the odor in the neighborhood was very unpleasant, and about a year ago it was found necessary to remove all the bodies from that part of

the inclosure. Cremation would have one sanitary advantage over interment, in avoiding the sickness which sometimes follows the customary exposure of those who attend burials in inclement weather.

FISKE (SAMUEL A.).—In a country as sparsely settled as the United States, and with large towns and cities supplied with water from streams or reservoirs of large size, and with the custom of burying the dead in cemeteries remote from dwellings,—which is becoming almost universal,—I think there is no danger to be apprehended from the burial of the dead.

GOODENOUGH.—I have not observed any instances in which diseases have been induced or aggravated by proximity of dwellings to cemeteries as yet. But there is a private cemetery laid out and occupied in part so near *my own* dwelling that I *have* feared and *do fear* that, if the lots are all taken up and filled, it might prove very unhealthy to the occupants at some future time. I have, therefore, purchased several lots nearest my dwelling, where some had been interred, and have part, and am about having the remainder, removed to more distant lots in this and other cemeteries at my own expense.

HITCHCOCK.—In answer to questions three and four, it would seem that, strictly speaking, any method was "*best*" which removed the possibility of injury to the living. Interment does, in my opinion, answer this requirement in most of the towns of the State, and may easily be made to do so in all. Cremation, or some other method, may be proved to be as good in a sanitary point of view as the known influence of the disinfecting power of humus or soil in general; but, until this is proved, the method by interment should be preferred when it is possible.

HOLMES (A. R.).—I consider interment the best method, when practised as I have seen it in South America. There the coffin is opened before burial and a quantity of quicklime thrown over the body. As a result, the soft parts are at once destroyed, all odor prevented, and at the end of a given time the bones are disposed of according to the wishes or ability of friends.

HOSMER.—It seems to me that the bodies of those who die of small-pox, certain forms of scarlet fever, erysipelas, puerperal disease, and diphtheria, should have the benefits of the disinfecting properties of heat, and be burned at once. The cremation-furnace would then become an appendage of the small-pox hospital.

NICKERSON.—I think that, although there is no urgent demand at present, on sanitary grounds, for the general employment of any new method of disposing of dead human bodies, the time will come, as it may have come in some cases already, when in crowded localities, some new plan of burial must be adopted.

PARKER.—For more than twenty years I have believed that the true way of disposing of the human dead is by rapid burning,—I say rapid, for chemistry teaches us that decomposition of the body, when interred, is but a *slow* process of combustion.

ROCKWELL.—Cremation, I have no doubt, in a sanitary point of view, is a better method than interment, of disposing of the dead, especially in a densely populated section of the country, or where bodies cannot be removed

from the neighborhood of dwellings; but in country places I believe interment to be perfectly safe.

SNOW.—Our cemeteries are situated on the southern and western borders of the city, so that the prevailing winds, south and west, must blow over them before we receive them, and yet we have one of the most healthy cities in the Commonwealth; have less typhoid and scarlet fever than any city of its size in the State.

SULLIVAN.—Theoretically, cremation seems to me to be a better method, in a sanitary point of view, of disposing of the dead than interment, especially when it (cremation) is performed according to the Roman method.

WEBSTER.—I consider cremation as a rational and suitable method of disposing of the dead, only objectionable at *present*, in consequence of educational prejudices.

WYMAN (M.).—In the present state of the arts, and by methods already in use, dead bodies can undoubtedly be destroyed by fire without offence or injury to health; the same object can be obtained by extra-mural interments. Sentiment will probably favor the latter.

Prof. HENRY M. ACLAND, *Oxford, Eng.*—My impression, shall I say my prejudice, personally, is, that inhumation is, in ordinary populations, the best scientifically, and the most congenial to humane feelings. I have, however, long felt that in dense populations some other mode of sepulture may become absolutely necessary. Scientific burning may be, no doubt, effectual; possibly, too, not inharmonious to society when once accustomed to it. Still, on a large scale (as two hundred a day, in London), it will not be devoid of some annoyance.

Dr. LIONEL S. BEALE, *London, Eng.*—Upon the whole, I consider interment the only method really available. I have been surprised that cremation should have been seriously recommended for disposing of the dead of large and populous cities. Some of the arguments put forward in its favor, and especially those from the economical point of view, appear to me ridiculous and unworthy of serious consideration.

P. H. HOLLAND, M. R. C. S., *London.*—I am quite convinced, as the result of my nearly twenty-one years' extensive observation, that interment in cemeteries of proper size, properly situated and properly managed, is perfectly safe; nay, if proper management could be always secured, would be safe, even in the close neighborhood of houses. But it is prudent and wise to leave them in open situations, both because land wanted for building on is very expensive, and therefore cemeteries close to houses would probably be too small to be safe; and, secondly, because as everything human is liable to mismanagement, therefore graves should be where, if accidental mismanagement should occur, serious mischief need not be feared. Another reason is, that bodies are sometimes brought for burial in an offensive or dangerous condition, from which injury might be caused if dwellings were very close; but, when there is nothing to obstruct the free passage of air, there is little practical risk to any one, and none at all to those at some moderate distance.

I do not see any practical advantage in the substitution of cremation for interment. Each is perfectly safe if perfectly conducted, but interment needs less elaborate care to render it safe; and any danger to be feared from bodies before burial would be just as great before burning, nay greater, if, as has been suggested, the place of burning be not as distant from inhabitants as the place of burial. I do not doubt that cremation might be, or that it *generally* would be, conducted with safety, but burial is almost invariably so conducted, and there seems to be nothing to gain by substituting the quick combustion by fire for the slow combustion of cremation, or decay, for no other apparent object than avoiding the employment for burial of a very moderate amount of land. So far from regretting that certain pieces of land are left near all our towns to be used first as places of sepulture, and afterwards as open spaces ornamented with trees and flowers, it is to be most earnestly desired that the quantity of land to be left only indirectly productive is not far greater. I deny entirely that the land for open spaces near towns is wasted; it is, on the contrary, put to a most valuable use. Such spaces both prolong our lives and make our lives better worth prolonging, as bad health embitters as well as shortens existence.

DR. JAS. H. KENNET, *London, Eng.*—In my opinion, the only objection to cremation is the feelings of survivors, and that is one that might be overcome by reason.

DR. HENRY LETHEBY, *Medical Officer of Health, and Food Analyst, London, Eng.*—As regards cremation, I see but one objection to it, and that is, the possibility, without great vigilance, of the defeat of justice in the case of secret murder; for if, by any means, the murderer could get the body of his victim destroyed by fire, there would be no after-evidence of poison, or what not.

If, therefore, cremation were the appointed means of disposing of the dead, it would be necessary that some properly qualified officers, and best, the medical officer of health, should inquire into the particulars of every sudden or mysterious death, and should communicate with the coroner or sheriff-substitute whenever he thinks a further investigation is necessary.

With this precaution, which would be essential to public safety, cremation would be the best means for the disposal of the dead.

Prof. CHAS. A. CAMERON, *Dublin, Ireland.*—I am of opinion that the earth is the proper receptacle for dead bodies, and dead organic matter generally, and, if the simplest and most obvious precautions are taken, the interment of dead bodies in cemeteries cannot give rise to any nuisance. Where bodies undergo decomposition in the open air, there are evolved from them carbonic anhydride, watery vapor, carburetted hydrogen, sulphuretted hydrogen, phosphuretted hydrogen, ammonia and solid particles of putrescent matter.

Beneath the clay, and especially in the presence of lime, the nitrogenous portion of the body, instead of flying off under the form of ammonia, becomes oxidized into the innoxious nitric acid; and all the above-named substances are oxidized in the pores of the soil. The emanations from bodies in badly-kept graveyards certainly possess a very offensive odor, but where there is no overcrowding, the air is perfectly sweet. There are three large suburban cemeteries in Dublin, the air and drainage-water of which I have found perfectly free from objectionable matters.

A few data may be here used to show how easy it is to prevent cemeteries from being nuisances injurious to health.

In a cemetery, the interments should not (as a matter of fact they do not, except in rare cases) exceed one hundred per acre per annum. Let us assume that the graves vary from three to eight feet in depth, and that the soil, or absorbent material, is only eight feet deep. About one-half of the human beings who enter this world, die before they attain the age of five years; as, therefore, the majority of the dead are children, and as the adults who die, are, as a rule, emaciated by disease, we may assume that the mean weight of a dead body is fifty pounds. One acre of soil, eight feet deep, weighs 2,650,000 pounds; therefore, the addition of one hundred bodies, weighing altogether 5,000 pounds, to the soil, would increase its weight to the extent of .1825 per cent. It must, however, be borne in mind that at least 80 per cent. of the weight of dead bodies consists of water and earthy matters; therefore, the 2,650,000 pounds of soil actually receives only 1,000 pounds of dry organic matter yearly, and that it is only this portion of the bodies from which gases and vapors injurious to health are evolved. Small as the quantity of organic matter above mentioned is, if it were allowed to accumulate, it would, in the course of years, assume dangerous proportions; but, if herbage be grown on the cemetery, organic matter cannot accumulate on the soil. The quantity of grass which might be obtained from an acre of a cemetery soil, I may put down at twelve tons yearly, but let us assume it to be only three tons. Grasses contain from 20 to 35 per cent. of dry organic matter. If we suppose herbage in the cemetery to contain only 25 per cent. of dry organic matter, then it follows that whilst 1,000 pounds of animal (dry) matter would be annually added to the soil, there would be removed from the latter, 1,680 pounds of dry vegetable matter. Four feet of soil above and three feet below a dead body would, in my opinion, act as perfect absorbents for the gases and vapors evolved during decomposition. Where a bad odor is observed in a cemetery, it is because the bodies interred therein are placed in close contact and near the surface.

I may here remark, that a heavily-manured field receives at one application a much larger quantity of decomposing organic matter than is placed in the same area of a cemetery during the whole year. An ordinary application of stable-dung is 40 tons per acre, containing about 5,000 or 6,000 pounds, weight of (dry) organic matter. It would be useful if the bottom of every grave was composed of a layer of burnt lime a few inches deep; this stratum would intercept the oozings from the coffins, and convert the most dangerous portion of them, namely, the nitrogenous, into nitric acid, with consequent formation of harmless calcium nitrate.

With respect to cremation, it would be better to burn the dead than to inter them in badly-kept cemeteries; but for the reasons above stated, I think it would in no wise be injurious to the public health were we to continue to bury our dead under conditions which would insure the quiet commingling of the elements of their bodies with the soil,—conditions which, as I have already remarked, are simple, obvious and practicable. As a matter of mere sentiment, I believe that the immense majority of the Christian world would prefer to consign their deceased relatives to the earth, rather than commit them to the flames.

Dr. C. R. AGNEW, *New York*.—I believe that cemeteries may be so placed as to make the pollution of the air and water-supply of communities impossible. Railroads and other means of rapid and cheap transportation,

make intra-mural interment easy and safe. The position of cemeteries with regard to the water-supply is a question of sanitary engineering. Where one well is polluted by the drainage of a burial-ground, *ten thousand* are polluted by the sewage of privy-sinks, barnyards and kitchens.

Dr. GEORGE M. BEARD, *New York*.—The amount of sickness that is demonstrably caused by cemeteries must be comparatively trifling. There is now, and for years there will be, plenty of space for the burial of the dead without any probability of injury to the living. There ought to be full freedom in this matter; those who prefer to be burned ought surely to have the privilege.

Dr. AUSTIN FLINT, *New York*.—I can only say that cremation is, in my feeling, at variance with the respect due to the beloved and honored dead. How far this sentiment may be owing to the influence of time-honored usage, I will not undertake to say.

Dr. JOHN ORDRONAU, *Roslyn, New York*.—Believing matter to be indestructible, I see no *teleological* difference between ashes or mould. Physically, we all eventually become C. H. N. O., but in doing so, I do not admit that we have any right to decompose our living neighbors by poisoning them atmospherically.

Dr. HENRY HARTSHORN, *Philadelphia*.—If burial be deep, one body only in each grave, and the cemeteries in secluded places *out of town*, and well planted with trees, it must be free from unsanitary tendencies. These conditions are not hard to obtain, at present, in this country, and the facility of securing them, as compared with the difficulty of effecting complete destruction by cremation, seems to me an important reason in favor of continuing the practice of interment. When, however, population becomes very crowded (as in England) and land very costly, the difficulties of perfect methods of interment must greatly increase. Then, I believe, cremation will be a very great improvement.

Dr. EDWIN M. SNOW, *Providence, R. I.*—In a sanitary point of view alone, there can be no doubt that, as a rule, cremation or any other process by which the animal matter will be most speedily and effectually destroyed or decomposed, is better than interment. But the possible danger from interment is not necessarily connected with it, but more generally arises from neglect or abuse in its practice.

Prof. R. C. KEDZIE, *Lansing, Mich.*—To-day I gathered a specimen of well-water, near the Lansing city cemetery, and the brief examination I have already given it, shows the presence of large amounts of chlorides and nitrates, a sensible amount of nitrites, and very distinct traces of phosphates.

Dr. CHAS. M. ELLIS, *Member State Board of Health, Elkton, Md.*—I believe that, with a careful selection of localities, removed but not remote from centres of population, good drainage being secured, we have in our present system of interments the best means of disposing of our dead.

Dr. S. L. JEPSON, *Health Officer, Wheeling, W. Va.*—Cremation is certainly the best method of disposing of the dead, provided nothing but the *sanitary*

bearings be taken into consideration; and provided the *means* of burning are so perfected as to be free from sanitary defects.

Dr. MANNING SIMONS, *Charleston, S. C.*—If interments be made at a suitable distance from cities and towns, my impression is that, so far as the health of communities is concerned, it is a safe method.

Dr. W. DUNCAN, *Savannah, Ga.*—Whilst our Medical Society consider cremation the best method of disposing of the dead, in a sanitary point of view, they fail to find an urgent necessity for it in the less crowded and densely populated cities.

Dr. JEROME COCHRAN, *Mobile, Ala.*—From a sanitary point of view, while I consider interment a very good method of disposing of the dead, I cannot say that I consider it the best method.

Dr. S. S. HERRICK, *New Orleans, La.*—I consider cremation the best plan yet devised for large cities, where suitable and sufficient ground for interment must be sought at inconvenient distances. As regards communities less densely populated, I think the matter has not yet become mature enough for discussion.

CONCLUSION.

The examination which we have attempted of the relative advantages of cremation and burial, has, of necessity, been imperfectly performed. As regards cremation, the fact that it has not yet been practised, in a scientific manner, on this side of the Atlantic, has made us dependent upon the reports of European experimenters, of whom the number has, as yet, been small. As regards burial, although the investigation has been made as thoroughly as the limited time at our disposal would permit, completeness having been especially aimed at in reference to the system as at present practised in Massachusetts, yet the study cannot be regarded as furnishing positive results until it has been pursued for a much longer time, by a large number of investigators. This further investigation we earnestly hope will be generally undertaken. In the meantime, the present investigation has yielded certain results which appear to us sufficiently definite to be summed up in the following aphorisms:—

1. Pyre cremation, as performed by the ancients and by modern Asiatic nations, is an incomplete and disgusting process, certain to load the atmosphere with noxious fumes, and not certain to thoroughly consume the organic portions of the body.

2. Cremation, accomplished by means of the Siemens furnace, at an enormously high temperature, the fumes being subjected to a second combustion, is a complete, rapid and inexpensive process, in no way offensive to bystanders, nor liable to contaminate the general atmosphere. Sir Henry Thompson's first method, by means of a double reverberatory furnace, is apparently almost as satisfactory.

3. The three methods of recent Italian experimenters are all unsatisfactory. The temperature attained by Brunetti and Polli is not sufficiently high, while Gorini's method, although as yet but imperfectly tested, must obviously be both inconvenient and expensive.

4. Burial in contracted spaces of ground, in the midst of cities and villages, as practised by all Christian nations from very early times until a period comparatively recent, and not yet wholly discontinued, has been repeatedly proved injurious to the health of the community, in proportion as such spaces of ground are overcrowded with bodies. This malignant influence is most apparent during epidemics, when the mortality in the vicinity of these burial-grounds has been frequently observed to be excessive.

5. Extra-mural interment, with regulations for the prevention of crowding, as now adopted by all of the largest cities of Europe and America, and very generally in smaller places, prevents, by removing the dead from the vicinity of the living, any possible injury to the public health. This plan, also, by increasing the number of public parks, is a positive sanitary benefit.

6. Burial, as now practised in Massachusetts, is partly extra-mural and partly intra-mural. Regulations in regard to the depth of graves, their distance apart, and distance from dwellings and wells, are less stringent than in several European countries; but boards of health are empowered to prevent burial-grounds from becoming nuisances. Any injury to health, even where the grounds are located in the midst of populous towns and villages, is in this State an almost unheard of occurrence.

7. In other parts of the United States, the same state of things exists as in Massachusetts, with the same general immunity from injury. In England, extra-mural interment is more general than here, and the laws relating to burial are more strict, and, except perhaps in rare cases of infraction of the laws, the public health is not affected.

8. The occasional injury to health from the proximity of burial-grounds which occurs or is likely to occur in this country, may easily be prevented by the complete abolition of the intra-mural system.

9. *Cremation, therefore, is an innovation not demanded in this country, on sanitary grounds; if, however, perfectly accomplished, by the best method known, there is no reason why its adoption should not be optional with all persons.*

Whether cremation or interment be the means employed for the disposal of the dead, the process ought to be regulated by state governments or state boards of health. Should cremation be adopted to any extent whatever, a board of inspectors should be appointed, who shall see that no unsuitable apparatus is made use of, and that the operation is properly conducted. This board should consist of engineers and physicians. Since cremation requires more complicated apparatus and more operative skill than burial, it is more likely than the latter process to be imperfectly accomplished. The difficulty of consuming a human body is very great, and it is improbable that it would always be performed with that completeness which has been attained in a few initial cases, under the supervision of scientific men and persons interested in the success of the project. The imperfect combustion of the gaseous products would create a nuisance at least as great as any ill-managed burial-ground could become, and therefore constant vigilance on the part of the inspectors would be requisite.

The precautions to insure the detection of criminal poisoning would necessarily be very carefully taken. The appointment, as suggested by Sir Henry Thompson, of officers corresponding to the French "*Médecins Vérificateurs des*

Décès," who should minutely examine into the circumstances of every death, would go far toward accomplishing this end; but, as it is unlikely that any community can be brought to adopt that other suggestion of his "to preserve, in every case of death, the stomach and a portion of one of the viscera, say for fifteen or twenty years, or thereabouts," the detection of poisoning would doubtless be sometimes prevented, the furnace standing to the murderer in the relation of "accessory after the fact."

But, since cremation has not yet come into vogue among us, and since the likelihood that it ever will do so to any great extent, is at least doubtful, we are at present more directly concerned with the practice of burial and the measures by which this may be made innocuous.

The incorporation in the statute law of regulations fixing the depth of graves, the superficial area allotted to each, and forbidding the use of vaults, unless the coffin be separately entombed in an air-tight manner, would insure uniformity throughout the State, and be an improvement upon the present plan of leaving the whole matter to the hypothetical wisdom of local boards of health, composed in the majority of towns of the selectmen.

We would also suggest the adoption of a regulation that no new cemetery shall be located within the limits of any city or village; that no grave shall be dug within two hundred yards of any dwelling, or any well used for drinking purposes; and that the perpetuity of this separation be secured by requiring every cemetery to be surrounded with a belt of land at least two hundred yards in width not used for interments. The planting of this belt with trees would be an additional safeguard, by interposing a barrier to the escape of any unwholesome miasmata into the neighborhood.

An additional requirement that every cemetery shall be discontinued for burial purposes before it becomes unduly crowded, and shall never be built upon, would effectually prevent the encroaching of cities upon them, which Sir Henry Thompson anticipates will eventually make all extra-mural cemeteries intra-mural; so that, as he says, we are now "laying by poison for our children's children, who will find our remains polluting their water-sources when that now distant plot is

covered, as it will be, more or less closely by human dwellings."

In all cases where the number of interments is large, and especially in times of epidemic, the free use of disinfectants would be a valuable precaution. Lime has been largely used for this purpose in all parts of the world, and has always proved so effectual, that Baron Larrey, in 1870, advised its use in the *fosses communes*, describing its action as a "slow cremation." Charcoal has also been found efficient. Sawdust saturated with chloride of zinc, or carbolic acid, and strewn upon the body, is preferred by Prof. Parkes.* These agents retard decomposition, while quicklime greatly accelerates the process.

With the adoption of such precautions as these, burial would become an absolutely safe method. We would, then, have all great cities furnished with rural cemeteries upon their outskirts, while the old cemeteries that had originally been in the country, but at last, both surrounded by the extension of population and sufficiently full, would remain as parks, contributing, by their presence, to the health and beauty of the city. We fully concur with Mr. Holland in the belief that "it is a glaring abuse of language to speak of such employment of land as wasted, for it would be in the highest degree useful; and, the more dense the population becomes, the more evident and important will that utility become also." The objection to this plan, that it places the cemeteries at too great a distance, requiring the funeral procession to make a long journey, at a great expense, can easily be overcome by the use of special railway trains for funerals. Railway transportation is already employed at some of the cemeteries of London, New York, Philadelphia, Chicago and Cincinnati, and is just being adopted on a large scale in connection with the new Parisian cemetery at Méry sur Oise.

For the use of all persons in winter, and of the very poor at all seasons, houses of reception might be permitted in various parts of a city, where remains may be deposited by friends, and thence conveyed by night, by a corps of respon-

* Pract. Hygiene, p. 446.

sible men, to the cemetery. This would be but a slight variation from the present custom of consigning remains to receiving-tombs during the winter.

Should cremation be proved a sanitary necessity, its adoption would doubtless soon be acquiesced in by all intelligent people; but, until it is so proved, we can see no sufficient cause for changing the present system of burial, which is endeared to the hearts of all Christendom by ties of religion and sentiment, and which, as practised in the rural cemeteries of to-day, is not, if properly regulated, open to any reasonable objection.

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HEALTH OF TOWNS.

HEALTH OF TOWNS.

Replies to our circulars have been received from one hundred and fifty-five towns,* and many correspondents have probably failed to answer, because they had only negative information to give. Their testimony as to the "avoidable causes" and "prevention" of diseases in their towns is as in previous years; and the importance of improvement in the hygienic conditions of a large number of dwellings, even in the smaller towns of the State, must be apparent even to the casual observer.

Our correspondents, with not many exceptions, report that an unusual degree of health has prevailed during the past year. There have been extremely few deaths from small-pox; typhoid fever has been in most cases of a very mild type, and less common than usual; and infantile diseases have been less fatal than in previous years, attributable, probably, to the absence of excessive heat during the summer months.

Early in the year, a severe epidemic of diphtheria appeared in Readsboro' and Whitingham, Vermont, in the valley of the Deerfield River, and, at about the same time, some severe cases were observed at Adams, in this State. From these two starting points the disease advanced slowly down the valley of the Deerfield, the towns of Florida, Heath, Coleraine, Greenfield, Leyden, and Conway having suffered especially. Arrived at the Connecticut, the epidemic spread chiefly along the western bank of that river, visiting West Springfield and Holyoke with some severity. On the eastern bank, Amherst suffered notably.

In the towns mentioned in the valley of the Deerfield, the mortality was very great, in some cases being as large as thirty

* One hundred and fifty-four were heard from last year. It is to be regretted that our returns are not more complete; but we give a summary of the general health of the State, as far as it could be ascertained, as possessing some interest.

per cent. of cases attacked; and in one village more than ten per cent. of the population suffered more or less severely. In these towns the mortality has been very much greater than from the epidemics which raged at the same time in New York, in western Germany, in some parts of France, and in isolated towns in other parts of our State. The absence of other diseases during the year was, in some cases, particularly noted.

Of the known elements in the causation or propagation of this disease, bad drainage and a saturated soil have often seemed the chief, while generally bad hygienic surroundings have been the apparent indication for unusual severity in the attacks, every single member of large families having suffered in some cases. It is worthy of remark, that the country flooded by the Mill River disaster did not suffer especially, although in the direct track of the disease. In three cases, the disease assumed a terribly malignant form in the immediate vicinity of decaying animal matter: first, near a slaughter-house; second, near the field where the offal was thrown; and third, close to the shed for rendering tallow. Some of our correspondents speak of the comparative immunity of the lower classes of foreigners from the zymotic diseases, although often living in most filthy condition. When such is proved to be the fact, it may be explained by the great infant mortality amongst them, acting like the exposure of the Spartan infants, and securing the survival of only the strongest.

In the southern part of Berkshire County, and also in a few towns on the eastern side of Worcester County, typhoid fever and scarlet fever prevailed. With those exceptions already mentioned, our correspondents from the middle and western parts of the State report general and unusual freedom from sickness.

In Essex and Suffolk counties, and in the eastern portions of Middlesex and Norfolk, there have been reported somewhat more than the usual amount of disease of the respiratory organs. In many places, there have been severe epidemics of scarlet fever and measles, and a few cases of diphtheria, generally mild.

In New Bedford, and its adjacent town of Dartmouth, there has been a severe epidemic of diphtheria, about one-third of the cases having proved fatal. In Seekonk, and the adjacent

towns of Pawtucket and Attleborough, scarlet fever in a severe form, and typhoid fever, prevailed. We think our correspondent is fully justified, from his own observations and from other evidence, in tracing a connection between severe forms of scarlet fever and the vicinity of decomposing animal matter, especially when the air is saturated with it from rendering establishments. With these exceptions, the health of Bristol County has been remarkably good.

From every town in Plymouth, Barnstable and Dukes counties, and from Nantucket, our correspondents, when heard from, have reported general good health, and no prevailing epidemic for any part of the year.

From many towns we have received statements as to the filthy condition of their slaughter-houses. Generally speaking, our correspondents think that meat sold in their markets is in good condition, although, in those towns which are supplied with cattle by rail, they think that there is avoidable suffering inflicted on the animals, to the detriment of their flesh as food.

The great annoyance and often serious injury to the sick from steam-whistles, have in many cases been complained of.

From Boston, East Boston, Holyoke, Amherst, Charlestown, Natick, Salem, Wakefield and Worcester, we have received suggestive statements in regard to sewerage and drainage.

As regards the unknown elements in the causation and propagation of the zymotic diseases, no new evidence is given. In the light of predisposing cause, during the prevalence of an epidemic, may be considered the occupancy of dwellings while the plaster is still moist (Seekonk and Conway).

Our correspondents call attention to the comparatively greater mortality in infants fed with any kind of artificial food.

From Somerville and Charlestown, are some interesting facts with regard to "Miller's River."

The population and death-rate of the cities and towns for 1874 are given where it has been possible to obtain them; and the tables of mortality will be of some interest.*

Those communications designated by an asterisk are from other than regular correspondents.

* See page 332 and also page 361.

Estimated Population and Death-Rate for each 1,000 Inhabitants, in Cities and Towns with a Population of 5,000 or over (as far as they could be ascertained), for the year 1874.

CITY OR TOWN.	Estimated Population.	Deaths per 1000.	CITY OR TOWN.	Estimated Population.	Deaths per 1000.
Boston, . . .	331,000	23.60	Woburn, . . .	9,600	16.26
Worcester, . . .	50,000	20.46	Malden, . . .	9,300	16.12
Lowell, . . .	49,000	24.12	Peabody, . . .	8,000	16.88
Cambridge, . . .	48,000	24.56	Marblehead, . . .	7,500	16.00
Fall River, . . .	44,000	26.75	Brookline, . . .	7,300	15.49
Springfield, . . .	33,000	18.33	Westfield, . . .	7,000	19.28
Lawrence, . . .	33,000	23.45	Natick, . . .	7,000	20.00
Lynn, . . .	31,000	20.45	Plymouth, . . .	6,500	20.92
Salem, . . .	26,000	19.00	Clinton, . . .	6,500	15.09
New Bedford, . . .	25,000	21.36	Medford, . . .	6,350	18.89
Chelsea, . . .	21,000	17.61	Hyde Park, . . .	6,200	20.96
Taunton, . . .	21,000	16.52	Wakefield, . . .	6,000	20.50
Somerville, . . .	20,000	24.20	Southbridge, . . .	6,000	16.00
Gloucester, . . .	17,000	21.94*	Abington, . . .	6,000	18.66
Holyoke, . . .	15,000	23.26	Andover, . . .	6,000	14.33
Haverhill, . . .	14,000	17.50	Leominster, . . .	5,500	13.63
Fitchburg, . . .	13,000	13.84	Frammingham, . . .	5,500	12.36
Newburyport, . . .	13,000	19.15	Webster, . . .	5,300	17.17
Pittsfield, . . .	12,500	20.13	Dedham, . . .	5,000	16.04
North Adams, . . .	12,000	23.08	Millbury, . . .	5,000	16.04
Weymouth, . . .	11,500	12.17	Provincetown, . . .	5,000	16.02
Northampton, . . .	11,000	23.00	Spencer, . . .	5,000	16.00
Chicopee, . . .	10,500	22.47	Stoneham, . . .	5,000	15.04
Waltham, . . .	10,000	15.20	Watertown, . . .	5,000	17.04
N. Bridgewater, . . .	10,000	16.00	Danvers, . . .	5,000	20.04
Milford, . . .	9,800	21.02			

* Of these, 68, or 18.21 per cent., were lost at sea; excluding these, the death-rate would be 17.94.

Alford.—500—16.—Typhoid fever has been unusually fatal and whooping-cough very severe, with a considerable loss of life among young children. The causes lie perhaps, in some cases, in bad sewerage.

Amherst.—4,035—17.84.—There has been very little severe sickness during the year. An epidemic of roseola in the spring, simulating very closely both rubeola and scarlatina, dysentery (mostly localized), rather less than the usual amount of disease of the respiratory organs, and typhoid fever, have been the diseases most prevalent. Typhoid fever began early, and still prevails; the number of cases having increased quite markedly within a number of weeks. There have been also a few mild cases of diphtheria. Typhoid fever has prevailed in various parts of the town, and in some of the most healthy localities. The localized cases of dysentery were undoubtedly caused by drinking-water shown by analysis to contain organic matter. This town is indeed "beautiful for situation," but can never hope to attain cleanliness, until it ceases to drink in impurities from its old long-used wells, and, by some system of sewerage, washes out the filth from its midst.

Andover.—6,000—14.33.—There has been no form of disease especially prevalent this year. Consumption is always here, but no more in this than in other years.

Arlington.—3,500—21.71.—We have had an unusual number of cases of typhoid fever.

Ashburnham.—2,300—15.21.—Typhoid fever has been specially prevalent, due to imperfect drainage.

Ashland.—2,100—21.9.—I have had ten cases of typhoid fever during the last three months; only two of them I considered dangerously sick; the other cases were marked by peculiar mildness of symptoms. One patient, a boy of fifteen, was confined to his bed only nine days, and three others were sick in the same family with the same disease. I attended four patients of these ten in one other family. These cases all pursued a mild course. The father was taken sick first. He was in the habit of going to Boston once a week to market vegetables, and *might* have caught the disease there. They lived in a farm-house in the near neighborhood of extensive woodlands. The immediate sanitary surroundings of this place were no worse than in the common run of farm establishments. The barn and pigsties were six rods from the house. An *open sink-drain*, with its water striking into the ground, ten feet from the house, and a privy, forty feet from the house, were in a neglected condition. Drinking-water all right. In the other house, a pig-pen is twenty-five feet from the house, a privy is at the same distance, and neglected, as usual; and the sink-spout water strikes into the ground just outside of the house. Their drinking-water they get from one of their neighbors, and it is all right. The first one who was taken sick in this family was a little girl of seven years, who, for a long time, had never been from home anywhere but to school, and there had been no other case of the disease in that vicinity. In these cases, diarrhœa requiring medical interference occurred three times, and the bowels were almost regular, or approaching constipation, in four cases. One boy had a pulse-rate of 44, and his brother one of 48, during early convalescence. Lead-poisoning has been a not unfrequent disease in this town during the last six years. I have seen sixteen cases in a population of 2,500. The means of introduction to the system were as follows:—In A and his wife, through lead water-pipes. In B, once from lead water-pipes, and again from using a lead faucet in his cider barrel. In C, D, E, F, G, and H, from water which passed through lead pipe. In I, from an aqueduct about 450 feet long. In K, L, M, from cider drawn through a lead pipe in a saloon. In N, from ale drawn through a lead pipe. In O and P, from small beer drawn through lead pipe in a saloon. I have had other cases where patients had obscure, indefinite ailments, which I suspected to be due to lead.

Ashby.—1,000—11.—The sanitary condition of this town, the past year, has been good. No deaths during the first six months, and mortality light for the remaining part of the year. Only two cases of typhoid fever have occurred.

Athol.—4,500—10.66.—The past year has been very healthy and free from epidemics. There has been a tendency to chills and fever, closely resembling intermittent; the period of febrile action short, and followed by a sweating stage.

Attleborough.—Scarlatina prevailed last spring, and typhoid fever during the autumn. On account of manufactories, an unusual proportion of our inhabitants are between the ages of fifteen and thirty-five, among whom typhoid fever exists.

Barnstable.—4,800—12.50.—No diseases especially prevalent.

Becket.—1,347—15.5.—A malignant form of scarlatina broke out here last spring, and was so fatal among children as to cause death in a few days, and, in some cases, in a few hours. Among adults, it generally ended in recovery. Diphtheria has been very severe in towns near here, and very fatal, but only slight here.

Belmont.—No severe epidemics.

Berkley.—750—13.40.—The diseases which I have met for several years have seemed to me to assume more of a bilious nature than formerly. Perhaps diet and regimen may be causes to some extent.

Boston.—The mortality returns, for 1874, indicate a decided improvement in the general health of the city over that of the two preceding years. There has been no prevailing epidemic, and the deaths from phthisis, as well as from miasmatic diseases, fall below those of 1873. A death rate of 2.76 per cent., excluding the mortality from small pox, as shown by the tables for 1872 and 1873, and also excluding in the estimate the statistics of the three recently annexed towns, had declined to 2.42, a ratio below the average for five years, as shown by the following table of the comparative mortality of Boston for those years:—

Y E A R S.	Estimated Population, (exclusive of W. Roxbury, Brighton and Charlestown).	Mortality.	Per cent.	EXCLUSIVE OF DEATHS FROM SMALL-POX.		
				Mortality.	Per cent.	Average Mortality for 5 years.
1870, . .	250,576	6,098	2.43	6,098	2.43	} 2.59
1871, . .	258,041	5,888	2.25	5,888	2.25	
1872, . .	265,782	8,088	3.05	7,270	2.76	
1873, . .	273,755	7,869	2.84	7,567	2.76	
1874, . .	281,967	6,840	2.42	6,840	2.42	

The wards in which the highest death rate is recorded, as noted in previous years, are the 2d, 7th and 15th. In these wards, the population is mostly foreign, the streets are narrow and often filthy, and the dwellings small, dark and badly ventilated. The excessive mortality in the 15th ward from phthisis and miasmatic diseases is fairly attributable to the foul emanations from the low and imperfectly drained soil that has, for some time past, distinguished that precinct, and is suggestive of one of the probable causes of the high death rate of the city for the last few years. In their recent excellent report, the City Board of Health dwell at considerable length, in language not to be misunderstood, upon the dangers that threaten the city from this source, and urge the great importance of some complete and comprehensive system of sewerage, not unlike that now in successful

operation in London, by which the sewage shall be conducted in properly constructed channels to deep water. "The whole system as it now exists," says the report, "is clearly wrong. Our beautiful city is almost encircled by the mouths of sewers, discharging their contents into shoal water or upon flats, the sewer gases rendering the atmosphere, for some distance about the wharves, dangerous to breathe." The Stony-Brook sewer, with its two open mouths, and that at the foot of Otter Street, in full view of many of the houses that skirt the bay, and of the skaters and oarsmen who resort thither for health or recreation, still pour forth their thousands of cubic feet daily of the foulest sewage-matter, to be deposited somewhere in the western basin, tainting alike air and water. The termini of these sewers, in the words of the report, should be forever hidden from sight and smell.

It remains to be seen what measures the city will adopt to rid itself of these sources of discomfort and disease. For many years relief has been sought in vain, and it is impossible to conjecture how soon it will come. In the meantime, the penalty of this unpardonable indifference and penny-wise policy falls upon those who are helpless to avert it.

Perhaps the most startling statement made by the Health Board is "*that there are large neighborhoods in the city entirely destitute of sewers, or of any proper means of getting rid of their vault, sink or cesspool drainage.*" The sentence closes with the somewhat superfluous clause, "and much sickness exists in these places in consequence."

With these facts before us, notwithstanding the decline in the death rate, in a year unusually free from epidemic influences, there is still a significance in the words of the City Registrar, in his last report, that the situation "assumes a serious aspect."

East Boston.—29,550.—18.4†—Since 1870, there have been great variations in the death-rate of East Boston from year to year. Between the years 1850 and 1870, the death-rate was quite uniform, seldom falling below 19 per 1,000 inhabitants, or rising above 21.3. There were two exceptional years observed. In 1855 the ratio was 23.6; in 1866 it fell to 17.2. Previous to 1850, the writer has not been successful in his efforts to find reliable statistics. The following table will show the number of deaths and the ratio per 1,000 for each of the years included in the table:—

	DEATHS.				
	1870.	1871.	1872.	1873.	1874.*
Population in 1870, . . . 25,484	513	414	790	610	499
Ratio per 1,000, ‡	20.1	15.6	28.6	21.3	18.4†
Deaths from small-pox, . . .	—	—	25	16	

* To December 1 (11 months).

† Nearly.

‡ The rate of increase of the population from 1865 to 1870 was 4.6 per cent. annually. It has been assumed that it has been 4 per cent. since 1870. If the number of deaths from December, 1874, should equal the average number for each of the preceding 11 months, the whole number for the year will be 544, and the ratio as given in the table.

The cause of these great variations in the death-rate from year to year is a subject of much interest and importance, and should receive more careful and thorough investigation than has yet been given it. So far as the writer can learn, from his own observation and from inquiry of those who should be familiar with the facts, no local nuisances nor imperfections in drainage or ventilation existed in the ward in 1872 that did not exist in 1871 and previous years; and there has been no material change in our drainage, or ventilation of buildings, or nuisances removed since 1872. The water-supply was, at times during that year, very impure, and offensive to sight, taste and smell. This fact led the writer to look in that direction for the cause of the great increase in the mortality that year over previous years. From 1850 to January 1, 1870, the water-supply of East Boston was from Lake Cochituate. Since the latter date, our supply has come from Mystic Lake. The first year of the use of Mystic water, the mortality was about the same as the average while using the Cochituate water. The second year, the ratio fell to 15.6,—less than any previous year. The third, it rose considerably above any previous year, and since that time it has been decreasing. Are there any peculiarities connected with the Mystic water to materially change its quality from year to year? Yes, there are. Those conversant with the facts are aware that the sewage of quite a large number of houses, the refuse of about twenty tanneries, one glue factory and one chemical manufactory are discharged into the pond or its tributaries. The refuse from the majority of these, as well as most of the sewage, is discharged into brooks, which, in dry seasons like 1871, do not flow; consequently, during dry times, the most of the sewage and refuse of the tanneries and other mechanical establishments are withheld from the pond until heavy rains wash the large accumulations of organic matter into it, to again vitiate its waters. One of the commissioners of inland fisheries, who has resided in Winchester, near the pond, for more than twenty years, has informed the writer that the water of the upper part of the pond became so impure, after the drought of 1871, as to kill a very large number of fish that ventured up the lake. He estimated the number of dead fish he saw floating upon the surface of the lake at that time, by millions. Is it not reasonable to suppose the water, that would destroy fish in such large numbers, would affect the health of those citizens who obtain their water-supply from that source? No one can doubt that there is danger to health in using water thus contaminated; and the danger will be greatly increased if the street-pipes are allowed to remain filled, or nearly so, with sediment, rich in organic matter, during the whole season, as ours were in 1872. As Chelsea, Charlestown and Somerville receive their water-supply from the same source, it becomes a matter of deep interest to learn whether their death-ratios had been subject to equal variations with those of East Boston. The following ratios of the aggregate deaths in the three cities will show that they have not. For convenience in comparing them, I will repeat those of East Boston:—

	1870.	1871.	1872.	1873.
Chelsea, Charlestown and Somerville, .	22.01	20.6	2.38	24.8
East Boston,	20.10	15.6	28.6	21.3

Had our investigations stopped here, these negative results would have led to the conclusion, that the large mortality in East Boston in 1872 could not be attributable to the impurities in our water. There are other facts, however, that are very suggestive and worthy of careful and thorough investigation. All of those cities use cement pipes in their streets for the distribution of the water. They are comparatively new, none having been in service ten years, and many of them considerably less. It is claimed for them, that crusts do not form in them, and that by use they become hard and smooth as glass, thus rendering it easy to remove all deposits from them by flushing. The service-pipes in East Boston are of iron, many of which have been in use since 1851. They are much roughened by tubercles and crusts containing organic matter, thus rendering it impossible to cleanse them. The heavy rains, which followed the drought in 1871, must have washed a large quantity of organic matter, that had accumulated about dwellings and the mechanical establishments above referred to, into the lake, and a portion of it found its way into the water-supply. In its passage through Somerville, Charlestown and Chelsea, to reach East Boston, the strong current would naturally prevent the deposit of organic matter to any extent in the mains of those cities, but would carry it forward to East Boston, which, being the end of the route, would lead to a dangerous accumulation in the pipes, unless they were frequently flushed.* This was the case in 1872, when the water was so offensive; and, although the attention of the Cochituate water board was repeatedly called to its condition, they were not sufficiently impressed with its importance to do anything toward its improvement. In the spring of 1873, a large delegation waited upon the board and urged that immediate measures be taken to improve our water. This led to the pipes being flushed. The water was improved, and our death-rate fell from 28.6 to 21.3, while, as will be observed, the death-rate of Charlestown and the other cities supplied from that source was increased. This year our water has been watched with greater care than it was last, and our death-rate still farther reduced. A table giving the number of deaths from each of the zymotic diseases for each year, and extending over a series of years, would be instructive in the study of this subject, but I have not found the time to prepare one.† The writer has, however, to satisfy himself as to whether his observation that sickness in the ward was not localized were correct, and also to learn whether change in the water-supply was attended with an increase of typhoid fever, caused a copy to be taken from the records of all the deaths in Boston from that disease from 1867 to 1873, inclusive, with date, number and street where each occurred. From this he finds that the number of deaths from that disease in East Boston was—

* With the exception of East Boston, the Mystic water-works are under the supervision of the Mystic water board. The writer is informed that the pipes under their charge were flushed early in the year 1872, while ours were not. May this not account for the discrepancy in the reports coming from Charlestown and East Boston as to the condition of the water that year, and also in part for the difference in their death-rates?

† I am glad to learn that the Registrar proposes to tabulate all the zymotic diseases by wards, in his future reports. This will greatly facilitate future investigations.

COCHITUATE WATER USED.						MYSTIC WATER USED.					
1867,	.	.	.	.	14	1870,	.	.	.	.	24
1868,	.	.	.	.	17	1871,	.	.	.	.	19
1869,	.	.	.	.	19	1872,	.	.	.	.	24
						1873,	.	.	.	.	31

These figures show that there has been an increase of the disease since the change in the water-supply. The statistics also prove that this disease has not been localized, but pretty evenly distributed over the ward. More of the deaths occurred, however, upon the lowlands than upon the highlands, where the drainage is apparently good, though the difference is not so great as was expected. Diseases of the bowels were quite prevalent here in 1872. It is to be regretted that accurate statistics cannot be given of those dying from these diseases, as accuracy in such investigations is of the utmost importance. That the Mystic water, at times at least, has an unfavorable influence upon the digestive organs, the writer does not doubt, as he has several patients under his charge upon whom one draught of it is frequently sufficient to bring on an attack of diarrhœa. A discontinuance of the use of Mystic water, unless it has been boiled, is sufficient with many to relieve derangement of the digestive organs, and to remove functional disturbance of the kidneys. The proposition to divert the sewage and refuse of the various mechanical establishments from the pond by means of proper sewers is the true policy, and it is to be hoped that the work will be commenced in the early spring, and be completed without unnecessary delay. This done, and the original purity of the Mystic waters maintained, they will prove, it is believed, very desirable for domestic use, and a valuable acquisition to the city. If East Boston can present a death-rate of 15.6 in 1871 and of 18.4 in 1874, when only a portion of the very objectionable organic matter above described is withheld for a part of the season from her water-supply, she may confidently hope to present a better record when *all* is diverted from it, and the distribution-pipes kept as carefully cleaned, as the above facts clearly suggest as being so essential to the preservation of the public health.

Brighton.—6,100—16.88.—I have had thirty-seven cases of typhoid fever in my practice during the past year. The causes are the improper construction of privy and cesspool vaults and a dry season, the latter favoring the passage of surface-water to wells in close proximity, in which the water was low.

Out of twenty-three persons who tried the *blood-cure*,* fifteen were females; more than two-thirds. The majority were born in the United States. All but two were between the ages of twenty and fifty; about one-half were married. Of the diseases, one-half suffered from disease of the lungs; anemia and general debility come next; dyspepsia, nervous debility and spinal trouble constitute the remainder. All could be classed as chronic, the patients having suffered from six months to ten years and upwards. Blood has been taken in quantities varying from one to eight ounces, over a period

* These investigations were begun at the abattoir late in the summer, after the cool weather had driven away most of the patients; but it is hoped that they will be completed another year.

from a single day to six and nine months, and, in most instances, daily. As to taste, we find as many different opinions as there were individuals, nearly. Five likened the taste to that of new milk. In most instances where diarrhoea followed its use, it was in those diseases where we should naturally look for trouble in the bowels, and, besides, it invariably followed large draughts. In nearly all the cases, the fæces were dark. In two instances, there was urticaria. In twelve instances, there was an actual gain in weight, in one there was a loss, in ten nothing was said as to gain or loss. In the single case where the patient lost, she still claimed to be "feeling stronger." All but six, almost three-fourths, claimed to have been improved by the use of the blood. One was certainly injured thereby, having not wholly recovered from ulcer of the stomach. All but one of the six suffered from derangement of the bowels in the form of diarrhoea, that one was completely covered with urticaria. Four of the six were far advanced in phthisis; one died while on "blood diet," another lived but a short time after she discontinued its use. Of anemia, there were three evidently well-marked cases, in all of which the persons expressed themselves as much improved, as did also those suffering from general and nervous debility, which come under a single class, perhaps. Of twelve suffering from lung trouble, four were obliged to give it up; the remaining eight expressed themselves as feeling stronger, and they had gained in weight. So far, then, as those few cases go, it would appear that blood taken into the stomach does not act as a specific in any form of disease. As food, it is of great value oftentimes. All those suffering from anemia with whom I conversed were unable to take iron in any form. In one instance, the improvement was very great, and nothing but blood was taken. The report as to taste would lead one to infer that it (the taste) was no barrier against taking the blood. The idea of drinking fresh blood is the main thing to overcome. When there was diarrhoea, I tried to have them defibrinate the blood, and one of them agreed to, but I never heard from him again; others would not consent to continue its use. That so many gained in weight, is of considerable value; in most, if not all the cases, *they were suffering directly from inanition.*

[Our correspondent incloses a statement from another physician practising in Brighton, as follows:—]

(*) I have had fourteen cases of typical typhoid fever. Six occurred under circumstances which seemed to point directly to a local cause. They were in one house and attacked members of the same family. At the door of the house was a heap of filth, ashes, slops and human excreta, continually kept moist by daily additions of filthy liquids.

As several other families used water from the same well with this family and were not affected, I concluded that it was free from deleterious substances.

These patients seemed so habituated to their surroundings, that the fever seemed to produce less effect, and was of a milder type than those cases occurring in families whose circumstances allowed them every comfort.

Brimfield.—1,289—6.20—It has been a remarkably healthy year in this town; not more than one-half the usual amount of sickness. I have had nearly every year a generous number of typhoid fever patients, but this year has been an exception.

Charlestown.—32,800—21.12.—(*) The following facts in regard to the subject (*i. e.*, the bad smells complained of in the city) are, I think, un-

disputed; first, that the odor in question is seldom complained of or noticed in the daytime, except by persons passing near the Mill Pond or Miller's River; second, that it is generally noticeable after sunset, at low barometric pressure of the atmosphere, and when the air is dense and muggy; and third, that few complaints concerning it have ever been made in cold weather. This last fact has an important bearing upon the question as to whether slaughter-houses are the *sole* cause of the nuisance. Upon this question, I desire to state the following facts, which have come within my own experience. For the past fourteen years, my professional duties have called me out a great deal in the night-time, and at all hours of the night. The bad smell, of which so much complaint has been made during the past three years, is nothing new, for I have noticed it and observed its peculiarities for the last twelve years or more, though not to so great a degree formerly as at present. My house stands at the corner of Main and Green Streets, in the Charlestown district of Boston, nearly on a level with the plain which extends from Main Street to West Newton. This plain contains many thousand acres. A considerable portion of it is densely populated; other parts are now occupied as tanneries and various kinds of manufacturing establishments, while other parts still, are covered with stagnant water, and open basins containing the deposits from sewers, and all manner of filth, from which the vilest odors are emitted. The hot rays of the sun, during the day, fall upon these open flats and stagnant waters, heating them to such a degree, that they exhale these odious gases, but the atmosphere dilutes and dissipates them, so that they are not noticed. But, after sundown, a rapid condensation of moisture from these places, forms a dense, damp atmosphere, which hangs over all this flat territory, rising to varying heights, according to the density of the air. A fog-bank, as it were, is formed, holding in solution, and retaining by its cohesive particles, all the gases and nauseous emanations which rise from tanneries, from Mill Pond, and open sewers, and in fact from every other source which emits the most unpleasant odor. This state of the atmosphere, I have frequently noticed, in going from my house to the top of Bunker Hill. The first breath of pure air is easily recognized as one emerges from this fog-bank. These gases, which are held down by this dense moisture, are cumulative, and are, therefore, more intense in the latter parts of the night; and, towards morning, a breeze springs up from the south-west or west, and wafts this fog-bank, freighted with its noisome gases, over our city, filling our houses, for half an hour or more, with its moist, intolerable odor. This I believe to be the true cause of our complaint. To remove one pork manufactory, would be removing but a tithe of that cause. To ascertain the whole cause, we must look to the tanneries along Canal Street, in Charlestown, the Mill Pond, the open sewers near the prison, Miller's River, and, in short, to all the collections of filth between Charlestown and Brighton. The trouble has been greatly aggravated, during the last few years, by the introduction of Mystic water into Charlestown and Somerville. Before this occurred, the out-houses in these places were properly emptied and the contents taken away; but now nearly every house has a water-closet, the contents of which are carried into the sewers, and thence discharged into open basins, or deposited on the flats, and there allowed to remain. To effect a remedy which shall be of any avail, the flats alluded to should be filled, the system of sewerage reformed, so that the contents thereof may be discharged in deep water, and all the establishments which can be proved to contribute perceptibly to the annoyance, be treated alike, and alike removed.

Chelsea.—21,000—17.61.—I think that in our city, for the past year, there has been less acute disease or sickness of any kind than for the year previous. Our city government has been doing considerable (not all that could be wished) within the present year to improve our drainage, and have filled up places on the marshy land in order to get rid of stagnant water. I also think the plentiful supply of water contributes towards diminishing sickness.

Clinton.—6,500—15.07.—Dysentery prevailed during August and September. Many cases were long in their duration and of a typhoid character.

Coleraine.—1,750—22.85.—Scarlet fever and diphtheria have prevailed to a considerable extent, and in a malignant form. I think that this has been in a measure owing to the state of the atmosphere, as they have not occurred so generally when fair weather was prevailing. Diphtheria was most fatal in two opposite sections of the town. In the first, the people lived on a high hill, *had been using swamp-water for culinary purposes*, and were generally very filthy. In the second section, the people were living *on the bank of Green River*, but I could ascertain no special cause for the outbreak and severity of the disease.

Conway.—1,400—27.85.—Conway lies west of the Connecticut River, is one of the second tier of towns, and is very hilly and dry, having no marsh land or swamps within its limits. A rapidly-running mill-stream courses through the town, on the banks of which are located one woollen-mill and two cotton-mills, which, with other kinds of business carried on, give support to a population of, perhaps, in the village, from four to five hundred inhabitants.

The year just past, had been unusually healthy; less than the usual average of deaths having occurred, previous to October. Reports had reached us of the prevalence of diphtheria in a number of towns at some distance to the north and west of us, in the towns of Readsborough, Whitingham, Coleraine, Leyden and Greenfield, when suddenly, and quite unexpectedly, about the middle of October, three children, in as many different families, living at a distance of half a mile from each other, and having had no particular communication with each other, were almost simultaneously attacked with a very malignant form of the disease, manifesting itself in severe inflammation of the tonsils, and of the parotid and sublingual glands, followed very soon with the white membranous exudation, covering the tonsils, fauces and palate, and often extending into the nares. The first death occurred in a girl ten years of age, and no local cause could be ascertained for the appearance of the disease, the hygienic condition of the house having been remarkably good. In a few days, a child of one of the other families fell a victim to the disease, and all the members of the family (six in number) were soon affected with the complaint, except the youngest, who was taken away to a neighbor's house. A second child in this family soon died, and after a short time the others became better. The house was thoroughly cleansed, lime-washed, painted and thoroughly aired, and after a time the young child was brought back to her home, but within two days she was taken sick and died in a few days. If there was any local cause here, to excite disease, it must have arisen from the fact that the tallow (often quite old and rancid) from a slaughter-house in the village was brought here to be stored in a small building in direct communication with the house, and "tried" in a little shed close by. The scraps and offal

were fed to hogs under the barn, which was in close proximity to the house. The third family, attacked at about the same time as the other two, lives on a hill at a distance of a half mile or more from the others. Here the disease assumed a very malignant form. The whole family, seven in number, were attacked. The mother contracted the disease by inoculation of a small prick in the finger, made by a splinter. Inflammation spread very rapidly up the arm, and terminated in gangrene and death in about twenty-four hours. Two children died soon after, but the other members of the family recovered. A sister of the father of the family, who came from a distant town to assist in the care of the sick, also contracted the disease by inoculation, while washing for the sick, went back to her home, and, after two or three weeks' suffering, died. Two sisters of the mother came to the funeral of their sister, from the town of Montague, fifteen miles distant, took the disease, returned home and soon died, as did also two or three others of their families. From this beginning, the disease has extended to numerous other families in the vicinity, four families having lost three members each, one having lost two, and others one each, until there have been twenty-one deaths; and the whole number of cases, of greater or less severity, have amounted to between seventy and eighty. The epidemic seemed to have spent its force in about six weeks; but there are still occasional cases occurring, mostly of a milder and more manageable type. What is remarkable in this epidemic,—all the deaths, and all the cases of any degree of severity, have occurred within a space of one mile from east to west, and one-fourth of a mile from north to south; although a very considerable proportion of the population of the village live outside of those limits. Another curious circumstance, is the fact that within these limits there are four tenement-blocks, filled with Irish and French-Canadians, living in the closely-packed way customary in such blocks, and yet they have almost wholly escaped the disease. There seems to be no satisfactory local cause for its severity within the above limits, unless it be, as some have supposed, that the business of slaughtering, which has been carried on for a number of years past in that neighborhood, has had a deleterious effect. It is true, however, that the families nearest to this establishment have not been affected, and the family of the owner, living in the upper story of the building where the slaughtering is done, have escaped the disease. A great deal of pains is taken to carry away the blood and offal to be fed to hogs, on a lot at some distance out of the village, but not far from the house of the family so malignantly diseased in the first breaking out of the epidemic. Other families, however, still nearer this locality, wholly escaped. Those who have suffered most severely, as a general rule, have been those families which have been least regardful of ordinary hygienic rules, who have a particular antipathy to soap and water, pure air, etc., and who are without comfortable clothing or generous diet.

In one house, where there were three deaths, there was no ascertainable cause of disease, except that the walls had been but recently plastered, and were still soft and damp.

The treatment most effective in my hands has been the tonic and stimulating. The larger number of fatal cases have been in young children from two to six years of age.

Dedham.—5,000—16.4.—Unusually healthy.

Douglas.—"Grinder's Consumption" is always prevalent here among the operatives.

Dover.—Consumption is prevalent (five fatal cases), one to every one hundred inhabitants. Three of those who died of consumption were children of an intemperate father. Otherwise, the town has been unusually healthy.

Dracut.—1,400—20—No sickness worthy of note.

Dudley.—The healthiest year for twenty-three years.

Everett.—3,800—16.84.—Pneumonia has been prevalent; due to improperly drained cellars near low marshes. One case of diphtheritic ophthalmia.

Fitchburg.—13,000—13.84.—The season has been more than usually healthy. Early in the spring, scarlatina appeared in a mild form. Late in the spring and early in the summer, inflammation of the bowels occurred in different sections of the city. During the summer and autumn months zymotic diseases have been less prevalent than usual.

The cases of scarlatina, for two or three years, have been more numerous and more severe in character in a section of our city located on shaded and springy land.

Florida.—This a small town upon the top of the Hoosac range of mountains, with a sparse population, almost entirely agricultural. There has been a number of cases of the prevailing epidemic of diphtheria here, with a greater average mortality than in Adams. The hygienic arrangements of our mountain towns are nearly all the same, and with little prospect of improving them.

Grafton.—4,500—12.88.—There has been much less diarrhœa and dysentery and typhoid fever than usual, during the summer months; nearly all the cases that have come under my observation have been of a mild type.

Granby.—863—12.75.—There has been an unusual number of cases of typhoid fever this fall; all recovered, and there were no severe cases. Supposed causes are an unusually wet spring, and decay of vegetation in the fall. Many years ago, typhoid fever was quite prevalent; now we do not often have a case. I think the improvement is due to improved drainage, and increased knowledge of sanitary laws among the people. Sickness has diminished 40 or 50 per cent. during the last twenty-five years.

Great Barrington.—Typhoid fever, of a mild type, has prevailed, due to bad drainage; wholly preventable in a very easy way.

Greenwich.—660—10.6.—We have had a most remarkably healthy year,—not one case of typhoid fever, where in previous years we had twenty. When typhoid fever has prevailed to any great extent, it was easy enough to trace the disease to causes in the immediate vicinity, usually from defective or no sewerage, as in Gilbertville, where a manufacturing population of nearly one thousand souls are crowded into tenement houses, without any sewerage whatever, and with their privies and wells in juxtaposition.

Haverhill.—14,000—17.5.—We have been unusually free from any special forms of disease during the year.

Hingham.—4,450—16.85.—No epidemic has visited us this year. There were

a few cases of typhoid fever, confined to the foreign population. The houses in which these cases occurred are in the worst part of the town, hygienically, although, for the locality, not poor houses.

Hopkinton.—4,500—14.44—Rheumatism has been specially prevalent. Several sudden deaths have been referred to rheumatic inflammation of the heart.

Holyoke.—15,000—23.26.—Holyoke has been nearly free from epidemics during the past year, and the general health of the city has been far above the average. This entire valley has been unusually exempt from all forms of disease. Summer came and went unattended by the diseases often present at that season. There has been a marked absence of those complaints that destroy the lives of so many young children during the hot months. In the fall, we escaped our annual visitation from typhoid fever, except in a very limited portion of the city, to which I shall refer further on. One cause for this improved health may be in the new and abundant supply of pure water from natural mountain-ponds. Formerly, the water for domestic use was pumped from the river into an artificial reservoir in the midst of the town, and thence distributed to the consumers—not always in very generous quantity. No sewers emptied into the river above where the water was taken out; but the conformation of the ground was such that the “surface-wash,” after a rain, must sometimes have found its way into the river, and thence into the stomachs of the people. Now, this is all changed, and the pure stream flows directly from the mountain-reservoir to the door of every citizen. Soon after the organization of our new city government, the more important hygienic rules and regulations were adopted, and have been enforced with commendable promptness and efficiency, while formerly matters of this nature had been conducted in the usual easy, “slipshod” manner characteristic of small villages and sparsely-settled towns. As a result, our streets and alleys, in the main, have presented a clean, tidy, wholesome appearance. But little difficulty has been experienced in enforcing the new laws, and the end attained is a higher standard of health, with a lower mortality-rate. At present (December), diphtheria and scarlet fever are somewhat prevalent, though in not very severe form. They first appeared about three weeks ago—here and there a case. Now, they are pretty generally scattered over the city. Each is occasionally met with alone; but more usually the diphtheria is a sequence to the scarlet fever. I have often seen this condition in solitary cases, but never before so constantly as in the present epidemic, for such this may now properly be called. Thus far, very few cases have terminated fatally. During the months of August and September, typhoid fever was very fatal in a small portion of the city, occupied exclusively by foreigners. It illustrates in such marked degree the cause or origin of the fever, that it seems proper for me to give a somewhat extended account of it. Some twenty-five years ago, while building the dam across the river at this point, the laborers—mostly foreigners—made homes for themselves and families on the bank above the dam. They have always retained possession of this locality, and their numbers have been constantly increased by the arrival of friends of their own nationality. The territory is nearly level, divided by a slight depression, through which the surface-water, in spring, and after heavy rainfalls, was discharged into the river. Gradually and imperceptibly, but steadily, this natural outlet for the surface-drainage had been closed up by the necessary filling-in of house lots and grading of streets, so that a cesspool of

no inconsiderable dimensions was formed in the immediate neighborhood. A sewer in this locality had been out of the question, because the formation of the ground was such that it could only discharge into the river a few rods above where water was obtained for domestic uses for the whole city. For years, the surface-water, and the drainage from privies, pigsties, and out-buildings of every description had accumulated in this cesspool. As soon as the new water-works were completed, a sewer was built, and this mass of liquid putrefaction was discharged into the river. But, through neglect, or forgetfulness, on the part of those intrusted with the work, the bed of this pool, reeking with filth, was left uncovered and exposed. A few days of hot sunshine and warm air sufficed to reveal its poisonous character. It was thickly inhabited on all sides by the poor and ignorant. Typhoid fever broke out almost in a day all around it, and in nearly every house could be found one or more cases. As might be expected, it proved terribly fatal. In a space but a little larger than a city square, nearly a score of deaths resulted. It seems to me there can be but one opinion as to the cause or origin of the disease here. In a population of nearly fifteen thousand, only one or two cases of typhoid fever are known to have occurred outside of this locality, while, within the district, almost every inhabitant suffered from the influence of the poison.

Lancaster.—1,800—17.77.—There has been rather more of typhoid fever and dysentery than usual.

Lawrence.—33,000—23.45.—This city has enjoyed an exceptional immunity from epidemic diseases during the past year. In December, scarlet fever and diphtheria were somewhat prevalent.

Leicester.—2,800—14.64.—Typhoid fever has been specially prevalent this year. In one part of the town, two shallow ponds have been drawn off, for the purpose of preparing dams, and it was here that the fever prevailed.

Lenox.—2,000—20.—During the months of July and August, there was more sickness among young children than usual, principally diseases of the bowels. The deaths, three in number, occurred in infants artificially fed. During the latter part of August and September, typhoid fever was prevalent. There were four cases, of which two were fatal, in two houses of the better class. The privies and wells of these houses are so situated that leakage from the former into the latter seems inevitable.

Leominster.—5,500—13.63.—Typhoid fever prevailed to a limited extent from August to November. The patients were young, from twelve or fifteen to twenty-five years of age. They were all, with but two exceptions, isolated, only one member of a family being affected.

Leverett.—800—13.75.—No typhoid fever this year; last year, it was quite prevalent. It is remarked by all physicians in the vicinity, that an uncommon state of health prevails.

Lincoln.—800—13.75.—In March and April, scarlet fever prevailed, in some neighborhoods malignant; in November and December, diphtheria and influenza and inflammatory sore throats were common.

Lowell.—49,000—24.12.—From January 1, 1874, to January 1, 1875, there

were 96 deaths from scarlet fever, out of a total mortality of 1,147. Next to that of the year 1868, when there were 95 deaths out of a total of 857, this is by far the largest annual percentage of fatal cases of scarlet fever for at least fourteen years. The average number of deaths during the ten years preceding 1874 was 31, out of an average mortality of 841. The greatest mortality from it last year was in the fall, especially in the month of October, when there were 17 deaths. Fifty-one of the fatal cases were buried this year in the Catholic cemetery, and last year 37, out of a total of 44. The present epidemic began in the spring of 1873, and has continued, without any marked abatement, since then. It is believed that the disease has been more generally diffused this year than last. The malignant form has not been so common as in 1873, when, especially in the fall, a large number of cases of this sort occurred in a district noted as unhealthy by me last year. The number of deaths from cholera infantum, *so called* (a large proportion of the diseases classified under this name being inaccurately named), from January 1, 1874, to December 1, was 128, against 82 during the same period in 1873, and against an average of 49 deaths during the ten years preceding. This is by far the largest number of deaths from this disease ever known in the history of this city. Of these 128 fatal cases, 94 were buried in the Catholic cemetery and 34 in the others. In 1873, 53 out of 82 were buried in the Catholic cemetery. In looking over the records of deaths for 1871, 1872, 1873 and 1874, I find that, out of an aggregate of 329 deaths from this disease, only 8 occurred in children over two years of age; so that we must put the limit of age in Lowell at two years and under. The percentage of deaths from cholera infantum in children under two years of age, in the year 1871, was 13 per cent.; in 1872, 24 per cent.; in 1873, 20 per cent.; and in 1874, 36 per cent. I cannot demonstrate any special cause for the unusual prevalence of certain diseases during the past year; but I cannot forbear stating, even though it be a trite remark, that the greatest amount of disease has existed where the hygienic conditions are the poorest. This statement is illustrated by the vast preponderance of sickness among the foreign population, notwithstanding their peculiarly rugged constitutions, and by the history of cholera infantum in Lowell during the past year, since the increase of this disease has been confined during this time to the lower classes. For eight years preceding 1870, the average annual mortality from this disease was 33. In 1870, the number of deaths suddenly went up to 70. This sudden increase was apparently due to the early appearance and steady maintenance of a high temperature. This was the hottest summer for the past thirteen years. It is a well-established fact that infants confined strictly to a diet of breast-milk are more exempt from disturbances of digestion than those artificially fed. An excess of food, even of the best sort, is injurious. Among the articles which I have known to be put into the stomachs of infants between the ages of three and twelve months are baked beans, boiled corn, pickles and mince pie. A certain nurse made the remark, as an illustration of the care with which she brought up her children, that she never thought of giving them beans until they were three months old. We have in Lowell an institution in which children are taken care of, whose mothers are unable, from various causes, to look after them; and, during the past summer, there has been no sickness of any account in it. The city physician of 1871 says, in his annual report for that year, that the decrease in the mortality from cholera infantum was doubtless owing to the labors of the old board of health in seeing that the streets, alleys, etc., were thoroughly cleansed, and the utmost care used to

prevent the crowding of the poor into unhealthy, miserable and ill-ventilated houses or places. I am inclined to think that, if we had had scarlet fever hospitals in 1873, the epidemic which took place in the autumn of that year might have been prevented.

Lynn.—31,000—20.45.—Scarlet fever was quite prevalent and of a malignant type during the first quarter. Typhoid has been and is prevalent, but not unusually so. It prevailed during the dry weather in September, subsided on the occurrence of rains the last of that month, and started up again as the drought returned. Many people persist in drinking well-water in the thickly-settled part of the city, where it is unfit for use. There is an abundant supply of pure water, so that the wells need not be used.

Malden.—9,300—16.12.—Typhoid fever has been unusually benignant in its type.

Marblehead.—7,500—16.—This town has been remarkably healthy during the last year. Parotitis has been very prevalent, with very few cases of sufficient severity to need the care of a physician. Occasionally, a case has been complicated with pneumonia. No diphtheria.

Millbury.—5,000—16.4.—We have had considerable typhoid fever. I cannot say that it has been especially prevalent this season. *There has been a decided tendency to intermit, which has not been usual in this vicinity.* Cause of the disease,—filth about our tenement houses.

Montague.—3,000—24.—An unusually healthy season.

Needham.—4,100—12.19.—From the middle of February to the first of May, pneumonia and scarlet fever were quite prevalent. In August and September, typhoid fever prevailed, a number of cases having been traced to the use of drinking-water contaminated by a broken drain.

Natick.—7,000—20.—Typhoid fever prevailed during the late fall, and scarlet fever the whole season. Five cases of typhoid occurred in one court, surrounded by fourteen (or thereabouts) privies.

Newburyport.—13,000—18.31.—We have had less sickness than at any time for ten years. In the spring months, we had but few cases of lung disease, and, during the summer, not one-half the usual number of cases of cholera infantum and dysentery. In September, October and November, typhoid and scarlet fevers, both of a mild type, have prevailed in a moderate degree.

North Adams.—12,000—23.03.—Diphtheria has prevailed in this locality for the past year as an epidemic; but this term has been applied to any existing affection of the throat quite too commonly.

The cases well marked by the diphtheritic exudation in the larynx, have been few in proportion to the multitude that exhibited the pharyngeal form. These latter have been in many cases severe indeed, extending over the posterior part of the pharynx and palate; but the fatality resulting from this fever has been comparatively light.

The mortality has been great when the larynx was involved. In some cases, death seemed to be the result of oedema of the glottis.

Of its causes, I know nothing. All classes and conditions appear equally subject to its influence, as also do all localities.

North Reading.—1,050—10.47.—Typhoid fever has been a prevailing disease to a greater or less extent for the past six years. Nine-tenths of this town is swamp and river-bottom not covered by water except in winter. Some cases have occurred from foul drinking-water, sink-drains, pigsties and privies too near wells.

Otis.—Our diseases are of a malarial type. We have a large area of ponds and a great deal of standing water.

Palmer.—There has been no form of disease prevalent this year. I have known no year so healthy for twenty-five years.

Peru.—450—8.88.—A large number of cases of diphtheria, in proportion to our number of inhabitants, have occurred during November. Some have proved fatal. It is noticeable that, as a rule, the most severe type of the disease is seen, and the fatal cases have occurred in those families thinly clad and poorly fed.

Quincy.—It has been a remarkably healthy year. We had a slight epidemic of scarlatina in the spring, with but few deaths, however.

Randolph.—4,000—15.75.—We have had no epidemic in this town or vicinity for more than one year. When we have had typhoid fever to a great extent, I am of the opinion that it was caused by bad drainage. Improve the drainage and sewerage of our towns, and many grave forms of disease would disappear.

Raynham.—1,700—14.11.—During the past year it has been unusually healthy. I have seen few cases but chronic ones in this town for the past year.

Reading.—The season has been a healthy one. There have been some cases of typhoid fever, but mostly of a mild character. This disease is often, in my opinion, due to filthy surroundings,—sink-drains, privies, and wells contaminated by them; and especially am I suspicious of the latter, but cannot always discover anything of the kind in fault.

Salem.—26,000—18.15.—In September of the past year, in a house upon Norman Street, there occurred two cases of sickness and death from typhoid fever. They were the fulfilment of expectations and the justification of predictions. The air of the premises had been made notably offensive and dangerous to life by emanations from a defective sewer. This sewer, although not recently constructed, had been made to form a part of a new system. The defect was gross. The bereaved father (too late to save his children) requested the aid of the city authorities to make his home habitable and to protect his property. This action, together with a public hearing given by our board of aldermen to owners of property, with reference to laying sewers, has given a painful vividness to these tragic illustrations of the dangers arising from imperfect sewers, and has excited a desirable interest in the causes which led to these deaths.

The circumstances relating to these cases of sickness are very instructive; I therefore report them. To assist the reader in understanding the following statements, I refer to the accompanying plan of the Creek-street section of sewerage.

Three-quarters of a century ago, the greater part of the territory bounded *on the south* by that portion of Broad Street which lies between Cambridge Street and Flint Street, *on the west* by Flint Street, *on the north* by an irregular line running from the junction of Flint with Essex Street, to the corner of Cambridge and Chestnut streets, was in a condition so different from its present, that, where now are the homes of the wealthy, frogs piped their simple melodies in praise of mud of velvet softness, and nestled sympathetically by grasses and rushes which enjoyed, like themselves, an aquatic home. In brief, it was a swamp, which had near its centre, in common with Boston, a "frog-pond." Water from this swamp and pond found an outlet through a water-course, whose direction is indicated by the dotted line on the accompanying map. The projection of this line between Summer and Crombie streets indicates a branch from the water-channel which drained a portion of land lying between these streets. The direction of this water-course was in part determined by a hill of moderate height and gentle inclination, whose northern slope is now the land bounded *on the north* by the southern side of the western third of Creek Street, and about five hundred feet of the eastern section of Broad Street; *on the east* by an irregular line drawn from the junction of the western with the middle third of Creek Street, to the corner of Mill and High streets. Creek Street occupies about the centre of what was once a salt-water cove, the shores about which were used as a ship-yard, known in olden time as "Knocker's Hole," because of the noise made there by the incessant hammering of ship-carpenters and caulkers. Mill Street, near where the Eastern Railroad depot now stands, was, fifty years ago, the boundary of a salt-water creek. A gentleman of sixty years tells me that he well remembers vessels lying by Mill Street, whose bowsprits projected over the street. The space where these vessels then lay has been made solid land, considerably beyond the border of the channel marked upon the map. The channel itself is a covered course, through which the sea-water ebbs and flows, on its way to and from a large pond which lies farther to the south.

When all the low land of this region was made habitable by filling it in with gravel, the water-course (indicated by the dotted line) was unfilled for several reasons: First. It was recorded in deeds as a boundary to estates and so could not legally be interfered with. Again, it was needed to drain excessive moisture from the land. Moreover, it could be used as a drain to convey refuse waters from the houses. It was protected, therefore, in various ways, according to the fancy of the owners through whose estates it ran. In places, its bottom and sides and cover were of loose stones. Elsewhere, its bottom and cover are of plank and its sides of stones. It was everywhere loosely built, with regard chiefly to its uses as a drain rather than a sewer. Its calibre was irregular and varied from twelve to twenty-four inches square. It ran under the back-yards of houses on Chestnut Street, until, near Cambridge Street, it passed directly under a house on the corner of these streets. It was covered several feet below the surface as far as the point on Norman Street, where it turns a right-angle to run south. Here, where it runs between two houses about three feet apart, it for many years remained uncovered, until, upon the petition of the abutters, the city, twenty or more years ago, covered it with plank. This decaying, it was several years ago re-covered with flagstones with loose joints. The bottom of the drain between these houses was about a foot below the earthen floor of their cellars. *The cellar-walls of loose stones formed its sides.* From Norman Street to Creek Street, the top of the drain is quite superficial. Its covering of stones is

hardly concealed with earth. During this part of its course, it runs under one corner of a house-shed and under a barn. In former times, great care was taken to keep the various natural water-courses of the city free from obstruction. At one time, we are told, Col. Perley Putnam (then a city official) took a posse of men to remove a privy which had been so placed that its droppings would enter this water-course. But, when water-closets came into extensive use, what had been intended for a simple drain was used for a sewer. Without misgiving, this miserable structure was trusted for many years, and by some is still used to convey sewage-filth, not merely closely by, but under dwellings. After a time, the occupants of the house on the corner of Chestnut and Cambridge streets were annoyed by offensive odors, which were traced to this drain, and effectually shut out by very thoroughly cementing the cellar-floor. During the years 1868 and 1869, the city built, with cement-pipes, a substantial sewer of large capacity, through Warren Street and Pickering Street to Chestnut Street, where it was made to enter pipes which were then laid from the head of Chestnut Street to the head of Norman Street. Similar pipes were laid under Essex Street from Beckford Street to Summer Street, and from Crombie Street to Summer Street. Then, the pipes continued through Summer Street to meet the Chestnut-street sewer at the head of Norman Street. The broken line on the map indicates the course and direction of this new sewer, which was completed by August of 1869. It was the intention of the engineer to have the pipes laid through Norman Street by the most direct course to a deep channel. But the abutters on Norman Street did not wish to be assessed for this new work, and the city authorities were unwilling to assume the whole expense. As a matter of economy, therefore, the very large body of sewage and surface-drainage brought by the new pipes to the head of Norman Street, were made to enter the weakly and loosely guarded water-course we have described, and which is indicated by the dotted line running irregularly from Norman Street, across Creek Street to Mill Street. From Mill Street, large cement-pipes were laid to the channel. The terminal pipe close to the bottom of the channel is uncovered only at extreme low water. It was soon found that, owing to obstructions or deficient calibre in the old drain crossing Creek Street, the water could not be rapidly enough delivered. After heavy rains or showers, waters which could not be discharged, backed up through the culverts on Norman and Chestnut Streets, so as to make the streets impassable and to flood cellars on Norman and the lower end of Chestnut and Summer streets. To remove this difficulty, new and large pipes were laid from the upper third of Creek Street to Mill Street, and thence to the new pipes already laid to the channel. This secured a more rapid emptying of the pipes and partially removed an alarming source of danger from the reflux of sewage into the yards and cellars of dwellings. But, as will be seen, the rising tide passes up into the sewer and at its height reaches a point near Norman Street. This retards the sewage flow, drives back the foul gases and compels their escape at defective points. The dangerous situation of the two houses, whose loosely-built cellar-walls formed now the sides of so large a sewer, can be seen. The occupants of the western house, after much annoyance, in self-defence sought aid from the city. Thereupon the authorities built a wall of brick and cement inside the cellar-wall. This shut out the odors from that cellar. No such precaution was taken in the eastern house. Soon, those living near the drain were annoyed by the odors which escaped through the uncemented joints in the flagstones with which it was covered. In warm weather, rather than suffer the stench with

which they were sure to be assailed if they opened their windows toward this sewer, they kept them closed. On complaint made, the loose joints in the sewer-cover were cemented. But the cementing of the cover compelled the sewer-air, when driven back by the rising tide, to escape through the culverts into the streets, at points quite distant, and through the loosely-built sides into the houses. How easily this occurred, is seen from the fact that the eastern house was at one time filled with the odor of carbolic acid which had been thrown into the sewer, through a sink-pipe from the western house. Last fall and summer, two persons, a young man of eighteen years and a young woman near the same age, son and daughter of the occupant of the eastern house, died of typhoid fever. One day during their sickness, the coverings of the old drain were raised and left open for several hours, with the effect of liberating foul air in such quantity, and so disgusting, as to produce sickness and vomiting among the occupants of the adjacent house. Among families living within two hundred and fifty feet of this faulty sewer, I have knowledge of twelve cases of typhoid fever, which have occurred since it has been overtaken by the changes made in 1869. Since the deaths in the eastern house, above named, our city government have lined the cellar-wall with a tightly cemented brick wall; yet, as the bottom of the drain is one foot below the cellar-floor, and the new brick lining scarcely reaches the bottom of the drain, we can hardly consider the premises safe. I am informed that it is now probable that the city will, before long, complete the new sewer by continuing the pipes through Norman Street. But the dilatoriness with which the proper authorities apply themselves to remove this, and similar dangers to human life, shows that the State Board of Health has yet an important work to do, in multiplying illustrations of casualties from defective sewer arrangements, and in giving line upon line and precept upon precept, until the people shall realize that it is *criminal* negligence to allow conditions productive of disease to remain when they can easily be removed, and until they themselves shall demand that the outlay of money and effort necessary for the public protection shall be *promptly* made. The dangerous nuisance about the shores of North River still remains uninterfered with. The pool back of the jail, bounded by Bridge Street, Northey Street and the Eastern Railroad, about which, and within a stone's throw of each other, as I stated last year, there have occurred twenty-one cases of typhoid fever within the last five years, menaces still the health and lives of those in its neighborhood. In both these cases, I believe the cost of making these infectious districts safe, would eventually be more than recovered to the city, in the increase of taxable property, while not only increased healthfulness, but also greater convenience of travel would be secured, and what are now offensive to sight and smell, might become attractive districts.

[NOTE.—Your correspondent is gratefully indebted to Mr. Charles A. Putnam, civil engineer, for the map of the Creek-street district, and to James Kimball, Esq., for many facts concerning its topographical history.]

(*) The more closely inhabited portion of the city of Salem was, for many years, and even down to the earlier part of the present century, confined to a broad tongue of land having the sea on the easterly end, its harbor lying between the south-easterly side and the shore of the neighboring town of Marblehead. From this harbor, at its southerly side, an inlet of the sea, known as *South River*, pushed for a short distance south-westerly and south-

erly, separating from the main town that portion known as *South Salem*, now (1874) extensively occupied by private dwellings. About one-eighth of a mile from the harbor, the erection of a dam, through the gates of which ascends the in-flowing tide, created a tide-water power, with an extensive reservoir above the dam, called the Mill Pond. The building of the Eastern Railroad, however, across the whole length of this reservoir, or Mill Pond, as locally called, practically destroyed this power, and a gradual filling up of the basin is going on. But, at low tide, a portion of the more shallow parts are exposed, and after a hot and dry day a palpable and most unwholesome miasma arises in the last degree offensive to the neighborhood. On the northerly side of the city, another inlet, locally known as the *North River*, puts in, having the towns of Beverly and North Salem on its northern side. Up this inlet, formerly uninterrupted by any bridge, the tide carried so large a body of water that vessels of some four hundred (400) tons were formerly built on its western banks and floated out to sea through Beverly Harbor. Now (1874) the Essex Bridge, connecting Salem and Beverly, Northfield Bridge, connecting Salem and its sixth or northern ward, the Essex Railroad viaduct and Carltonville Bridge, locally so called, and the dam at Frye's Mills, all impede the passage of the tide-waters. At the viaduct and at Carltonville Bridge, where a few years ago the North River was one hundred and fifty feet wide, it is reduced by these structures to less than thirty feet; and, all along its northerly banks, and at the south-western extremity, a gradual filling-in at the numerous tan-yards has materially lessened the area formerly flooded at high water. But it is above the Frye's mill-dam that the area has been still more lessened. This North River, which, as above intimated, is really but an inlet of the sea, received in former times the waters of Goldthwaite's Brook, a stream which—crossing Peabody Square and there joining Proctor's Brook, which brings down the water from Spring, Brown's and Bartholemew's Ponds and from the marshy grounds in their vicinity in the present town of Peabody (formerly South Danvers)—discharges them into the inlet called the North River. This stream, running easterly, follows the valley between the high grounds of Peabody and those of North Salem, near the Harmony Grove Cemetery. All along its banks, from Peabody Square to Frye's Mill, it has gradually been encroached upon so that in some places its course is materially interrupted; and what was once a free and fast-running stream is, in many places, especially at times when a full reservoir is created by the shutting of the mill-gates at high water, without any downward current. The brook has also been materially narrowed by the accretion of wastage from a bleachery, two glue factories and the tanning and currying establishments on each side of its banks, and by being used as the receptacle of all sorts of drainage and filthy sewage. This has been going on so long that, in some places, the old banks of the stream have been extended into the brook, interrupting its flow and forming areas filled with festering and pestilential matter, which exhales from slimy ditches stanches at times of the most offensive sort. Especially offensive is the effluvium in the night, after a hot and muggy day, and of so diffusive a nature as to be recognized at the distance of half a mile. The attention of the authorities of Salem and Peabody has been often called to the subject and a remedy proposed, but the expense cannot but be very great; and this has caused and now causes inaction in the matter. This remedy, involving the loss of the water-power at Frye's Mills, is the conversion of the stream from Peabody Square, whence "Proctor's Brook" passes toward the reservoir above the mills (together with the res-

ervoir and the area below the mill-dam down to Northfield Bridge) a distance of something like one and a half miles in length, into a drain of some thirty feet wide, and filling up all the rest.* The solid area thus created would be of many acres, and would amount to a large increase of taxable property to both municipalities.

Seekonk.—1,000—23.—Pulmonary and bronchial affections were quite prevalent during the winter months throughout the town. Typhoid fever, with a few exceptions of a mild form, has prevailed over the southern and middle sections. The prevalence of respiratory diseases was due to the varying conditions of the atmosphere and the many sudden changes of temperature. Whooping-cough, complicated with severe bronchitis, existed on the highest and most exposed parts of the town. Typhoid fever has been confined to the fall months and in the vicinity of low, marshy grounds. The season has been unusually dry and the springs very low. In few of the cases only have I been able to find any contamination of the water, offensive cesspools, pig-sties or privies, to which I could attribute the disease. One very remarkable fact for a country town with so few new buildings, is, that most, and these the worst, cases have occurred in newly-built houses. The worst case in town was in a new house, occupied before the walls were even dry, the cellar of which was used for a cook-room, while the cemented floor and walls would easily yield an impression. The house was built on the side of a gravelly hill opening to the south and east, close by a mill-pond that was almost dry during a greater part of the summer and autumn, leaving much decomposing vegetation, exhaling an offensive odor. Quite a number of families live by the side of this pond, but no other case of fever or bowel affection has occurred for some years. In January, scarlet fever broke out in the bone-boiling district of East Providence, which was formerly designated "Seekonk Plains," being limited, with few exceptions, to a radius of one-fourth to one-half a mile. From one or two families, it gradually increased till it attacked the whole community, scarcely escaping a single house, sparing neither age nor condition, and assuming almost a malignant type. Hemorrhage and albuminaria were the characteristic features of the epidemic, though many died of the throat affection, and others from the effect of the poison upon the nervous system. During this epidemic, a family living in Seekonk removed half a mile from the nearest case of the disease, and the five children were all attacked with scarlet fever. One of them died within twenty-four hours, two others in a week, and the fourth soon after, while the fifth, a girl of sixteen or eighteen years, who narrowly escaped death from diphtheria a few years previously, was confined to her bed several days with sore throat, and soon after had an attack of severe erysipelas of the face and head, but recovered.

Shelburne.—1,700—15.88.—Diphtheria has been prevalent in a mild form, also whooping-cough.

Somerville.—20,000—24.2.—Scarlet fever and cholera infantum have been more than usually prevalent, and were almost entirely confined to the foreign population, who generally choose the low, damp localities, where considerate individuals would not be willing to locate. I think such diseases are not so particular about *localities* as about the sanitary regulations

* Would an open drain, however wide, be a *permanent* or *efficient* remedy?—[ED.]

of households. More bad smells might be boxed up from dirty dwellings in Somerville than from Miller's River. It is because the nuisance is not unroofed that the air is not laden with bad odors. Miller's River, as a nuisance, is so far obliterated as to be reckoned among the things that were.

[Another physician writes from Somerville, as follows:—]

(*) We have experienced little difficulty from Miller's River this summer, and I think none from the portion which is filled in. We have some odor at low tide from the flats just beyond the Lowell Railroad, but are very little troubled, and *none in comparison with last year*. We have a smell sometimes, which we think is the smell of "rendering," and which *seems* to come from the vicinity complained of. If we had never been troubled more than now, however, we should have hardly thought it necessary to complain. If we *could have it*, we would like it *less* than at present.

[A professional chemist gives the following extract from his note-book in regard to the only night during the past year when he had any trouble:—]

"SUNDAY, August 30, 1874.

(*) "Woke up about 2.45 this morning; there was a most horrible stench in the house; went down to the front door; found it came from the outside. It was an unmistakable rendering smell, such as is produced when sour meat is tried out. It was coming in freely at our room window. I did not think it quite so strong down stairs as up. The wind was easterly in the evening and was the same direction in the morning.*

South Dennis.—I have had eighteen cases of typhoid fever in a village of about twenty families in this town. These occurred in the vicinity of a partially drained cranberry swamp, which will be completely drained before another season.

Sterling.—1,670—10.79.—This has been a year of unusually good health in this town. In one locality, acute bronchitis was epidemic, visiting almost every house, and in a greater or less degree (with a few exceptions) affecting every member of the family.

Stoneham.—5,000—15.4.—There has lately been a larger number of mild cases of diphtheria than usual.

Topsfield.—1,213—19.78.—Measles in a severe form prevailed during the first half of the year. There were about 140 cases, many of which were attended with severe pulmonary complications. Pneumonia has been prevalent here for eight or ten years, more so than it was fifteen years ago.

Upton.—2,000—16.5.—Scarlet fever in a severe form, mild pneumonia, and enteric diseases have predominated. The histories of the cases point to over-work, and inattention to physical needs, and the daily changes of temperature.

* Our correspondent states that the nearest rendering establishment known to him is about one and a quarter miles south of east from his house; that he found it in a worse condition on December 29 than he had ever seen it before; and that four other such establishments are about as near, and in the same general direction, while the others are rather farther off.

Uxbridge.—3,100—13.29.—Inflammatory diseases of the lungs have been more than usually prevalent during the first half of the year, attributed to the coldness and frequent changes in temperature during that period.

Wakefield.—6,000—20.5.—Typhoid fever and diphtheria have prevailed. For the enteric fever, I have no doubt that a principal cause is to be found in the universal proximity in this town of wells and privies, sink-drains, etc., and the entire lack of sewerage that exists. Good systems of water-supply and drainage are imperatively demanded.

The diphtheria has been most prevalent in a certain locality on high land, but in crowded Irish tenements. There have been, in a very small space on the hillside spoken of, some seven or eight deaths, with quite a large number of non-fatal cases. Elsewhere in the town the cases are rare.

Waltham.—10,000—15.2.—The health of this town has been remarkably good.

Warwick.—800—15.—Typhoid fever has been most prevalent of all diseases, but less so than usual.

Of a family consisting of four individuals who lived on the banks of a mill-pond, which dried up last August, exhaling a disagreeable odor, three were attacked with typhoid fever. A daughter, living sixty miles distant, made a short visit to her parental home, contracted the fever, returned home, and died. Typhoid fever is the greatest scourge to which farmers are subject. Many of them are very negligent about their privies, barn-yards and kitchen slops. In too many instances, the well-water becomes contaminated by its proximity to the privies and water from the sinks, giving it an unpleasant odor that those constantly using it do not perceive.

Wayland.—Scarlet fever prevailed in March, April and May, in all forms, from mild to malignant. It seemed to be increased from the fog from the river.

Generally, the health of the town this year has been unusually good.

Webster.—5,300—17.17.—With the exception of a mild type of whooping-cough and typhoid fever, this town has been unusually free from disease for more than a year.

Westford.—1,800—15.—Tonsillitis was unusually prevalent in the early part of the year.

West Springfield.—2,900—25.17.—In the first part of the autumn months, diphtheria was quite prevalent; just now, typhoid fever is gaining an unusual number of victims. I could not discover any cause for the former disease; but with regard to the fever, just before the first cases we had unusual fogs, beginning very early in the evening and lasting till noon, sometimes even the whole day. They were the more remarkable from the ground's being unusually dry. The town has grown rapidly, and the privies and wells are close together; but a sewer is now building, which will, I hope, abate one great cause of disease.

Weymouth.—11,500—12.57.—Typhoid fever has been unusually mild.

Winchendon.—3,500—20.57.—During the first six months of the year, there

was an unusual prevalence of rainy and damp weather. For month after month of the winter, rain and snow succeeded each other at very short intervals. About the 10th of February, a severe form of "sore throat" began to prevail, chiefly among adults, and characterized by high pulse (120) and temperature (105°), and by general febrile symptoms. The attack was extremely abrupt. There were pain in throat and difficulty in swallowing, with swelling of the glands of the neck. The throat presented a dark, angry redness, the tonsils swollen, with little patches of altered secretion, the uvula glued to one side, etc. One of us had 85 well marked cases. A few cases were followed by mild fever of two or three weeks' duration. A large number had abdominal pain of a severe nature for a week after. Seventeen cases of rheumatic fever occurred. Typhoid fever was very much less common than during the past few years, notwithstanding the dryness of the autumnal months and the marked offensiveness of the marshes and river-bed.

Winchester.—3,500—12.—In the latter part of September and in October, a mild form of influenza was very common, which has continued into November; has often been accompanied with inflammation of fauces and larynx; sometimes with severe *diphtheria*, from which two children died in November. I never knew so little or so mild "summer disease" in all its forms as during the past year.

Windsor.—No disease has prevailed to any unusual extent.

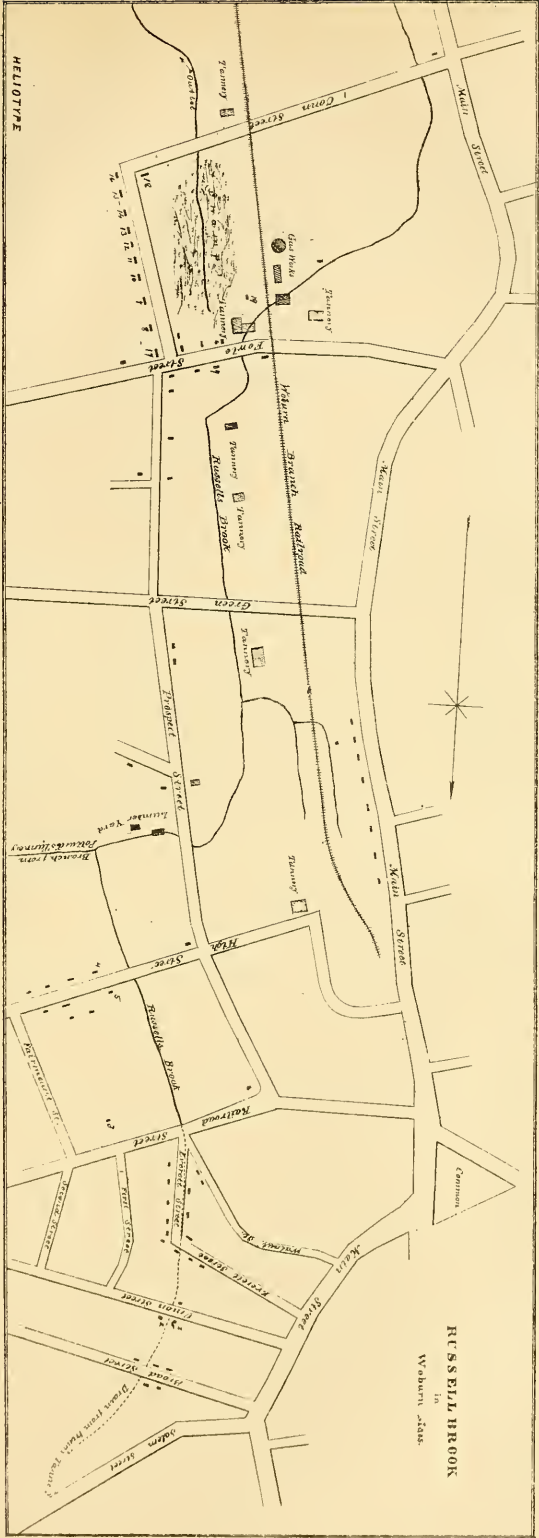
Woburn.—9,600—16.04.—This town has about ten thousand inhabitants, whose principal occupation is the tanning and currying of leather. It lies about ten miles from the sea, and the centre of the town is about one hundred feet above the sea level. It is one of the important parts of the watershed of the Mystic River. Many of the streams that feed this river arise in Woburn. Several tanneries pollute these streams, being situated on or near the banks, with their refuse products and sewage flowing into them. Of these products, the spent "bark-liquor," containing gallate of iron, is injurious to vegetation, and renders the stream useless for domestic purposes; but it cannot be regarded as positively contaminating the atmosphere. The compounds of "water-washings," lime, hen-manure and "fleshings," constitute the most offensive ingredients of the polluted stream, particularly when it is small, shallow and tortuous. It is said, and probably truly, that tanneries *in themselves* are not prejudicial to the health of the people living near them. Those on Russell Brook, eight in number, are large; they have been used many years, and they discharge their sewage, with one exception, into a single small stream, which receives also the refuse from two currying establishments, one gas-house and numerous dwellings. The section of the brook into which all this filth is poured is about one mile long, three feet wide, and usually about six inches deep. The upper part, for about one-quarter of this distance, has been converted into an ordinary brick sewer, with several traps to permit the entrance of the surface-drainage. The remainder is still an open, polluted stream. Where this is covered, the sole complaint is on account of a disagreeable smell coming through the "traps." This stench, arising from the refuse of the tanneries, is often complained of as an intolerable nuisance; but it is doubtful whether disease has been caused by it. Formerly, the nuisance was so intolerable at this place, that the proprietors of the adjacent tannery built the present

"barrel-drain" at their own expense; and the well-water in the vicinity, which had been previously too much contaminated for use, became pure again.

In November, 1874, the following facts were ascertained of the different localities in the course of the stream. *Broad Street*: Smell but seldom noticed. [See map.] *Union Street*: There are "traps" near the street, and the odor has been complained of; sometimes causing a feeling of prostration. A death from typhoid fever occurred here a few years ago. In the house marked "1," a family has lived for eight years, and has been annoyed by the odor more or less during the whole of that time. Before the sewer was built, paint was turned black in their house, and their well-water was rendered unfit for use. Within a few years, there have been in this house one death from diphtheria and two cases of typhoid fever, one of which proved fatal. The general health of the family is far from vigorous. In the house marked "2," the stench has been such an annoyance that persons sleeping on the side of the house nearest to it have been obliged to keep their windows closed in summer. Recently, the head of the family, a professional man in the prime of life, died in this house, of typhoid pneumonia. From this evidence, it will be seen that the traps of the sewers have not been effectual in preventing the escape of foul emanations. *Everett Street*: The stream runs below the sidewalk on the westerly side of the street, and there are several traps. The population is dense and shifting, many of the residents seldom remaining over a year. In one case, a family left the neighborhood solely on account of the stench, which is especially bad near a trap close to the entrance of a house-drain. The well-water along the lower end of this street has so disagreeable a taste that the residents generally will not drink it. The illness of one person in this neighborhood is attributed entirely to this odor, which comes forth from the "traps" concentrated and extremely offensive. *Railroad Street* crosses the sewer, and is elevated above the level of the meadow land by almost eight feet. At this point, the sewer becomes an open brook, sluggish, shallow and in the highest degree offensive. One person, living near by, says that his cattle will not eat the grass growing on its banks. He mentions several deaths which have been attributed to the foul condition of the air. At the house marked "3" there is some odor. *High Street* is crossed by the open channel of this offensive brook; and, from the eight or nine houses in the vicinity, there is universal complaint of a "disgusting and sickening nuisance." Several of the wells have been contaminated. In each of the houses marked "4" and "5" a case of typhoid fever has lately occurred. The vegetation found generally in brooks is entirely wanting here, so that a great means of purification of the filthy water is lost. *Prospect Street*: The smell is very offensive here, and paint has been turned black. People have undoubtedly been deterred from locating in Woburn from this cause. Below Prospect Street, the stream becomes larger, and the smell resembles that noticed about tanneries, the water being quite black.

Taking a general view of the whole stream, it may be said that the offence is greatest in the middle portion, where many house-drains, privies, etc., empty into it.

Within the last ten years, there has been a large number of deaths in this district, especially from consumption, typhoid fever, diphtheria and scarlet fever. During the past summer and fall, when the brook was in its worst condition, there was sickness in most of the houses. It is fair to infer that the prevalence of disease was influenced, if not caused, by the polluted stream,



RUSSELL BROOK
in
Woburn, Mass.

HELIOTYPE

because the residents in this district live in good houses, and are intelligent, careful and well provided.

Another source of disease is a small pond near Conn Street, into which has flowed the drainage of two tanneries. The outlet of this pond has become obstructed by tan-bark, etc., so that a mire of considerable size has been formed. In the house marked "6," there were two cases of typhoid fever this season; in "7," there was one; and, on Conn Street, there were twelve cases at one time. In "8," there has been no sickness, but some complaint of the bad smell.

The water used for drinking is from Horn Pond. In "9," well-water is used, and three cases of typhoid fever occurred, of which one was fatal. In "10," well-water used,—two cases of typhoid fever. In the block "11," there were, in November, four cases of typhoid in two tenements, the others remaining vacant because of the sickness in that locality. In block "12," there was one case of typhoid fever this season. In houses "13," "14," "15" and "16," there has been much complaint of bad smells, but no special sickness. In block "18," three persons were sick with diphtheria at the time of this inquiry. The general health of tenants in this block is poor, and the well-water used by them is turbid and discolored. On Fowle Street, the residents complain grievously of the smell arising from the nuisance in their rear. The house on Fowle Street, where there were two cases of typhoid fever, was so filled with the sickening odor, that the writer of this communication was sickened, and with difficulty kept from vomiting. Year after year, petitions have been sent to the local board of health, and they have done all that they could do without rendering the town liable to a lawsuit. As before stated, the covering of the brook from Salem street to Railroad Street was adopted as the best mode of relief. Below the latter street, it has been the practice, when the brook was dry, and the stench unusually offensive, to dig out its bed, and throw the semi-solid mire on either side, allowing it to dry there; a proceeding the immediate result of which was to make matters worse. It is desirable that there should be a *general sewer law*, as we have a general railroad law. The introduction of water, by reservoirs, etc., into so many towns and cities has become so general throughout the State, that unless proper sewers are supplied, the public health must suffer, and many able-bodied citizens will be lost to the community by typhoid fever and similar diseases.

[Our correspondent calls attention to the prevalence of decayed teeth, which he considers as peculiar to civilized life, and which he ascribes to the withdrawal of the mineral salts from the food largely eaten in modern society. Statistics are quoted from "How Plants Grow," showing that the mineral ash from whole wheat is about four times as great as that from fine wheaten flour. The following two cases are given as illustrations of this theory:] "1. A native of Prince Edward Island, possessing a perfectly sound set of teeth, came to Massachusetts seven years ago. At the present time, she has lost about half her teeth; and, while she has been in this State, she has subsisted mainly on flour bread, which she did not eat before. 2. A dentist had filled fourteen cavities in the teeth of his first-born child at the age of four years. His family then gave up the use of fine flour, eating meat, the whole grains, etc., and another child, born somewhat later, had perfectly sound teeth when four years old."

[Our correspondent sends the following table, showing the prevalence

of decayed teeth among the pupils in the schools of Woburn. He shows that the evil is not confined to one town. Probably statistics taken throughout the State would give similar results; and American dentists in France and Germany say the same of those countries.]

NAME OF TOWN.	Age of Scholars examined.	No. of Scholars examined.	No. having sound Teeth.	No. having decayed Teeth.
Woburn,	5 to 8 years, .	42	6	36
"	" " .	43	3	40
"	" " .	28	4	24
"	" " .	26	12	14
"	" " .	45	11	34
"	" " .	94	27	67
"	" " .	39	9	30
"	" " .	50	15	35
"	" " .	24	5	19
"	" " .	23	10	13
"	8 to 12 years,	33	11	22
		447	113	335
Lexington,	5 to 8 years, .	30	7	23
"	" " .	50	13	37
"	8 to 12 years,	30	3	27
"	" " .	50	2	48
		160	25	135
Concord,	5 to 8 years, .	30	3	27
"	" " .	39	11	28
"	" " .	18	4	14
"	8 to 12 years,	38	4	34
		125	22	103
Bedford,	5 to 8 years,	35	2	33
"	10 to 20 " .	40	11	29
		75	13	62

[Our correspondent states that the teeth of foreigners (in Woburn) are in a much better condition than those of native Americans.]

Worcester.—50,000—20.46.—During the summer months, there was a large number of cases of diarrhœa and cholera infantum in certain parts of the city, due to the filthiness of the sections. In certain parts of the city, the stench was outrageous, owing to drains opening into the streets.

*Death-rates in some American Cities during the Year 1874.**

CITY.	Estimated Population.	Deaths per 1,000.	CITY.	Estimated Population.	Deaths per 1,000.
New York, . .	1,040,000	27.61	Memphis, . .	50,000	22.96
Philadelphia, . .	775,000	19.54	Lowell, . . .	49,000	24.12
Brooklyn, . . .	450,000	24.46	Cambridge, . .	48,000	24.56
St. Louis, . . .	400,000	16.27	Hartford, . . .	45,000	12.86
Chicago, . . .	395,000	20.31	Fall River, . .	44,000	26.75
Baltimore,† . .	350,000	21.14	Reading, . . .	42,000	18.66
Boston,‡ . . .	331,000	23.60	St. Paul, . . .	40,000	16.03
Buffalo, . . .	175,000	18.46	Paterson, . . .	38,000	23.35
Cleveland, . .	145,000	16.69	Portland, . . .	35,000	19.08
Dist. of Columbia, .	150,000	19.72	Lawrence, . . .	33,000	23.45
“ “ whites, . .	110,000	15.71	Springfield, . .	33,000	18.33
“ “ col’ed, . .	40,000	30.77	Utica,	32,000	16.42
Pittsburg, . . .	137,000	24.69	Lynn,	31,000	20.45
Newark,	115,000	29.16	Quincy, Ill., . .	30,000	18.76
Detroit,	110,000	21.69	Springfield, Ill., .	30,000	12.23
Milwaukee, . . .	100,000	19.09	Fort Wayne, . . .	30,000	17.30
Providence, . . .	100,000	19.86	Savannah, . . .	29,000	35.38
Albany,	95,000	15.30	Terre Haute, . .	25,000	12.20
Allegheny, . . .	75,000	19.77	Norfolk,	24,000	18.08
Richmond, . . .	65,000	24.47	Dubuque,	22,000	12.32
Syracuse,§ . . .	60,000	15.20	Augusta,	20,000	28.65
New Haven, . . .	58,000	19.50	Bangor,	20,000	15.65
Toledo,	55,000	10.90	Omaha,	20,000	11.00
Troy,	50,000	29.00	Norwich,	18,000	21.35
Charleston, . . .	50,000	38.96	Concord, N. H., .	14,000	13.15
Worcester, . . .	50,000	20.46	Newport,	13,000	12.30

* As given by the registrars in answer to enquiries sent to one hundred cities. The very low mortality of some of the cities suggests the idea that the registration may not have been complete.

† From October 31, 1873, to October 31, 1874.

‡ Including all annexations.

§ Exclusive of 75 drowned in the flood of July 26.

REPORT ON THE SANITARY CONDITION

OF THE

STATE PRISON AT CHARLESTOWN.

REPORT ON THE SANITARY CONDITION OF THE STATE PRISON AT CHARLESTOWN.*

Hon. J. C. ROBINSON, *Secretary Board of Prisons Committee.*

DEAR SIR:—In compliance with a request made to the Chairman of the State Board of Health, we, as a Committee to whom the matter was referred, desire to make the following statement in regard to the State Prison and the land connected with it, considered from a sanitary point of view:—

In the location of the prison, we agree with its founders, officers and inspectors in the opinion, as generally expressed, that there is nothing in that of itself absolutely prejudicial to health, although, for many reasons, the place is not desirable; the present yard of five acres is smaller than the demands of health would require, and thorough ventilation and drainage are difficult of attainment, if at all possible, on such low land.

The fact, too, that the floors of the various wings are even with the surface of the soil,—which is only two feet above the level of the water at high tide, and quite near it,—must, as stated by the inspectors in their report for the year 1852, cause dampness in some of the lower cells, which is “hazardous to health.” This evil is, however, to a great degree obviated, from the fact that the floors of the cells rest upon stone foundations several feet deep, and not directly upon the ground.

External to the prison, and not far distant, is an evident source of danger to health in the flats upon which the sewage of Charlestown and of the prison are spread and exposed to the air; so that, for several years, it has not infrequently been necessary to close windows, in order to avoid the intoler-

* The previous papers were sent to the Senate in manuscript, January 20, 1875; and this report was made while the others were going through the press.

erable stench, and that, too, in summer, when the necessity for ventilation by open windows is the greatest.

In regard to the health of the prison itself, an examination of the annual reports for the past fifty-five years discloses the following facts :—

From 1805—the date of completion of the original prison—to 1828, inclusive, there were 2,176 prisoners committed, and 114 deaths, or 47.8 to each 1,000 *commitments*. This death-rate was then thought to be great, and to call for a remedy. The convicts slept in dormitories containing from six to sixteen individuals each, with close doors, and with little chinks in the walls to admit air and sunshine.

In 1829, the new prison (the present north wing) was completed, with small windows. It contained 304 cells, with close doors, each containing a space of $171\frac{1}{2}$ cubic feet; and from that date to the end of 1865, when crowding began to be marked, the mortality was only 34 to each 1,000; while from 1866 to 1874, inclusive, the death-rate has been a trifle under 50 to each 1,000 commitments.

A glance at the following table shows these facts :—

TABLE NO. I.

YEARS.	No. of Convicts in the Prison at the end of each year.	No. of Deaths per 1,000 for each year.	Total No. of Pardons for each year.	YEARS.	No. of Convicts in the Prison at the end of each year.	No. of Deaths per 1,000 for each year.	Total No. of Pardons for each year.
1820,	308	19.4	25	1838,	302	23.3	21
1821,	282	17.7	32	1839,	318	15.7	7
1822,	279	35.8	14	1840,	322	6.1	14
1823,	308	19.4	6	1841,	331	24.1	26
1824,	298	20.1	10	1842,	287	6.9	6
1825,	314	3.2	13	1843,	265	7.5	13
1826,	313	19.2	14	1844,	276	7.2	15
1827,	285	3.5	27	1845,	280	3.6	8
1828,	290	13.8	14	1846,	253	3.9	7
1829,	323	18.5	7	1847,	288	—	7
1830,	290	17.2	7	1848,	281	10.6	27
1831,	290	24.1	12	1849,	349	8.6	15
1832,	256	42.9	10	1850,	440	13.6	10
1833,	250	24.	7	1851,	472	11.8	13
1834,	277	14.4	17	1852,	483	8.3	20
1835,	279	10.8	13	1853,	491	8.1	22
1836,	278	14.4	7	1854,	483	16.6	26
1837,	291	17.2	14	1855,	457	6.6	26

TABLE No. I—*Concluded.*

YEARS.	No. of Convicts in the Prison at the end of each year.	No. of Deaths per 1,000 for each year.	Total No. of Pardons for each year.	YEARS.	No. of Convicts in the Prison at the end of each year.	No. of Deaths per 1,000 for each year.	Total No. of Pardons for each year.
1856,	452	8.8	27	1866,	518	17.4	16
1857,	440	9.1	29	1867,	647	10.8	13
1858,	483	4.1	26	1868,	558	10.7	34
1859,	491	16.3	8	1869,	593	11.8	30
1860,	502	7.9	11	1870,	563	24.8	63
1861,	547	18.3	30	1871,	543	14.7	36
1862,	460	21.7	54	1872,	562	33.8	16
1863,	408	17.1	28	1873,	586	15.3	10
1864,	351	14.2	30	1874,	683	20.5	20
1865,	379	13.2	25				

In the days of the old prison (since remodelled in 1852, enlarged in 1867, and constituting the present west wing), the mortality was considerable, being 17 to each 1,000 *residents* per year for the ten years ending in 1829. This high rate has already been explained.

In 1830, after the occupation of the "new prison," when one would have expected the death-rate to fall, it remained stationary; and in 1831 it rose considerably,—facts difficult to explain, unless it came from living in a newly-finished, incompletely dried, and consequently damp, stone building.

During the year of the cholera epidemic (1832), there were in the prison 195 cases presenting more or less the symptoms of that disease, although none died directly from it; but the general death-rate was excessive (42.9), as was to be expected.

In 1833, when the mortality was great, Dr. Walker stated in his report, that "low fever, of a typhoid character, was prevalent."

In 1834, the mortality of the previous three years had caused some alarm, and great efforts were made to improve the sanitary condition of the prison. These efforts bore fruit in the lower death-rates of the three succeeding years,—a fact which was noticed in the report of the physician in 1836. The weak convicts in the prison, too, had probably many of them died during the epidemics of 1832 and 1833.

In 1837, "low fever" was prevalent again, and the death-rate rose.

In 1838 occurred the first death by violence of which we find note; and, excluding this, the death-rate would be 19.5. In this year, too, was the first mention of a death from pneumonia.

In 1841, the death-rate was high, but fully compensated for by the extremely low rates of the previous and succeeding years.

From 1842 to 1849, inclusive, during which time the average number of convicts was small (285), a period of unusual health prevailed, and the average yearly death-rate per 1,000 was only six.

During 1850 and 1851, the average number of convicts in the prison had increased, respectively, 60 and nearly 70 per cent. above the average of the previous eight years; there were complaints of crowding (although the cells were not all occupied), diarrhœa prevailed; and the mortality increased.

On the completion of the new south wing, in 1852, with 150 cells, of $309\frac{1}{2}$ cubic feet each, and with the remodelling of the west wing for 100 cells a little larger than those in the south wing, together with the introduction of Cochituate water, the mortality decreased, and did not, until 1861, reach the figure of even 10 to the 1,000, except in 1854, when there were three cases of small-pox and 205 cases of severe choleraic diarrhœa treated, and in 1859, when the higher rate was more than compensated for by very low rates in 1858 and 1860.

In 1860 and 1861, just about the beginning of the war, the prison was crowded, and the high death-rates of 1861, 1862 and 1863 can probably be accounted for in that way; the low death-rate in 1860, in spite of the large number of convicts, following directly upon the placing of large windows in the north wing, admitting air and sunshine, which had been pretty well kept out by the old, small windows.

In 1862, 1863, 1864 and 1865, during the war, there were fewer commitments, and the number of convicts in the prison diminished materially, as did the death-rate.

At the close of the war, in 1866, the number again increased, with an increase in the death-rate.

In 1867, by enlarging the west wing, 98 more cells were added to the 554 already existing. Grated doors, admitting more air, were placed in the cells of the north wing in 1868, and the death-rate became lower for three years.

Since that time, the mortality has been excessive, while the prison has been about three-quarters full, or full.

From the figures in the fourth column, it will be seen that the variation in the number of pardons from year to year would not in any probability have seriously affected the results arrived at.

It has been estimated, however, by careful computations, that the *true* death-rate is *at least* twenty-five per cent. higher than the figures we have given, many men having been pardoned in the last months of their lives.

From a consideration of the second table (dividing the period into six of nine years each, and beginning after the cholera and typhoid fever years), the following facts will be apparent:—

TABLE NO. II.

YEARS.	Average number of convicts in prison, yearly.	Total number of deaths in nine years.	Death-rate per 1,000 per year.	Number of pardons per each 1,000 per year.	Average number of days' sickness for each convict per year.	Percentage of deaths from consumption.	Annual death-rate per 1,000, excluding consumption.
1821 to 1829, .	292	45	17.0	52.0	—	—	—
1830 to 1838, .	278	52	20.6	47.1	11.9	55.0*	9.4*
1839 to 1847, .	291	23	8.7	43.1	7.6*	43.5	4.8
1848 to 1856, .	434	41	10.5	47.6	4.9	48.3	5.0
1857 to 1865, .	451	54	13.3	59.0	3.7	47.6	6.6
1866 to 1874, .	584	93	17.8	45.0	4.6	62.3	6.7

* Computed for eight years, the data being wanting for the ninth.

1. The total death-rate has progressively increased (since 1839), and finally doubled.

2. The relative mortality from consumption has also increased, and from 43.5 per cent. to 62.3 per cent. of the total number of deaths.

3. The death-rate from all causes, excluding consumption, has also progressively increased, and from 4.8 in each 1,000 to 6.7, an increase of 40 per cent.

4. The number of pardons has not been subject to sufficient variation from year to year to vitiate the above results.

5. The number of days' illness to each man during the year has decreased, and is certainly very small. As this column represents, to a great degree, transient illnesses, the fact can be probably explained by the greater attention to sanitary laws and to preventive medicine from year to year.

Finally. This progressive increase in the death-rate has taken place in spite of many and great improvements in the prison.

Previous to 1831, the causes of death were not uniformly stated. In 1832, 1833, 1839, 1849 and 1852, there were deaths from typhoid fever. In 1834 and 1835, there were deaths from "fever"; and in 1837, a "low fever" prevailed.

After the introduction of Cochituate water and the other improvements already mentioned, in 1852, there was not a case of fever until 1866, when the prison was crowded, and one death occurred. There were deaths from the same disease also in 1868 and 1874, and one from "fever" in 1870.

In 1869, 1870 and 1871, acute pulmonary diseases became prevalent for the first time.

Of 19 deaths in 1872, 12 were from consumption; of 9 in 1873, 8 were from the same cause; and in 1874, with 683 convicts for 654 cells, there died of pneumonia, 1; typhoid fever, 1; typhoid pneumonia, 2; consumption, 8; and the death-rate for the year was 20.5.

From 1805 to 1874, inclusive, there have been 383 deaths. From 1831 to the end of 1874, there have been 258 deaths; of which 131 were from consumption, 8 from typhoid fever, 4 from "fever," and 5 from pneumonia. Four of the deaths from fever occurred after the early part of 1866, and all of the cases of pneumonia, with one exception (in 1838), occurred after that year.

The deduction which we draw from these facts is, that the prison, as now constructed, cannot be occupied to more than about three-fourths of its full capacity without an alarming increase in its mortality.

The mortality from all other causes, *excluding consumption*, since 1839, has not at any time been great, the average yearly chances of death in the 9 years ending in 1874 having been 67 in 10,000 (or, adding twenty-five per cent. for pardons, 84 in 10,000), while for all males from 20 to 70 years old in the State, the chances are about 80 in 10,000.

The death-rate in Massachusetts for all males over twenty and under seventy years of age varies a little on either side of 12.5 in 1,000; and in the prison, from 1866 to 1874, it was 17.8 (or, adding one-fourth, 22.25); in 1874, it was 20.5 (or 25.6); and from 1870 to 1874, inclusive, it was 21.8 (or 27.25).

In order to compare the mortality with other prisons, the following table has been prepared, including, as far as possible, those of the same class as the prison in Charlestown:—

TABLE No. III.

PRISONS.	No. of Years.	Annual Death-rate per 1,000 prisoners.
Austria (long sentences), prisons for males,	2	71.0
Italy, prisons in general,	1	50.9
France, prisons for men,	—	36.5
Austria (short sentences), prisons for men,	2	33.0
Connecticut (U. S.) State prison,	18	24.3
New York (U. S.), Auburn,	18	17.8
Belgium, prisons in general,	1	17.7
Denmark, prisons in general,	2	17.5
Massachusetts (U. S.) State prison,	18	17.2
England, all convict prisons for men,	15	13.8
Norway,	—	9.7
Switzerland,	—	6 to 16
Germany, prisons for men,	—	10 to 27

TABLE No. III.—Concluded.

PRISONS.	ANNUAL DEATH-RATE PER 1,000 PRISONERS.	
	1868.*	1873.*
Ohio, State prison,	22.8	40.0
Maryland, State prison,	30.5	30.0
Maine, State prison,	36.3	15.0
Kentucky, State prison,	11.0	35.0
Indiana, Southern prison,	30.0	10.0
Michigan, State prison,	18.1	10.0
Massachusetts, State prison,	10.7	15.3
Pennsylvania, Western prison,	6.8	15.0
Iowa, State prison,	10.0	10.7
New York, Sing Sing,	10.8	10.0
New York, Auburn,	10.5	10.0
Wisconsin, State prison,	5.1	10.0
Indiana, Northern prison,	6.8	5.0

* These two years were taken as the statistics happened to be of easy access, and time was wanting for further comparisons.

It will be seen that the mortality in most prisons on the continent of Europe is much greater than in Charlestown. With the exception of those in Belgium and Switzerland and individual prisons in Germany, however, their sanitary condition is bad. Scurvy is mentioned as a common disease in many of them; and, in Austrian prisons, this most thoroughly preventable disease causes 9.2 per cent. of all the deaths.

The death-rate in our prison, up to 1870 and after 1839, compares favorably, too, with the rates in the majority of American prisons; but, if we take a high standard of comparison,—the prisons of Great Britain,—we shall see that for the past five years our death-rate has been excessive. Major E. F. Du Cane, R.E., Surveyor-General of Prisons in Great Britain, says of them, in a report published in 1872: "The history of the prisons for many years has shown an entire absence of epidemics within them. . . . In the construction of the prisons, most careful attention is paid to the important questions of drainage and ventilation"; and it

will be seen from the table that their death-rate is quite moderate.

In investigating the causes of the great mortality of late in this prison, it is clear that we have only three points to elucidate:—

1. Why there should be so many deaths from consumption.
2. What should make the mortality of certain, and especially the last five, years as great.
3. Why typhoid fever and pneumonia have recently appeared and caused several deaths, after having been unknown in the prison for so many years.

The three results are considered to be due to a common cause, and the three questions will be answered together.

Probably a large number of the convicts, possibly a quarter or a third of those who die in the prison, were suffering from incurable disease when sentenced. It is unfortunate that no statistics are to be found on this point; but a consideration of the following table will show that at least a majority must contract the diseases of which they die in the prison:—

TABLE NO. IV.

Showing Death-rates, etc., according to the Length of Sentences, from 1828 to 1864, inclusive.

LENGTH OF SENTENCE IN YEARS.	No. of Men sen- tenced.	No. of Men par- doned.	No. Pardoned per 1,000.	No. of Men who died.	Death-rate per 1,000.	Death-rate per 1,000, exclud- ing those par- doned.
Less than 2, . . .	1,160	20	17.2	14	12.0	12.2
2 to 3,	1,214	84	69.3	25	20.2	22.1
3 to 5,	1,318	160	121.4	35	26.4	30.1
5 to 10,	849	212	249.2	38	44.7	59.6
10 and over, . . .	238	76	316.4	28	118.1	173.8
For life,	183	95	519.1	28	153.0	315.9

It has been stated, and probably with truth, that convicts in Massachusetts are more broken down by excesses of all kinds now than they were fifty years ago, when our cities were small; and this fact would account in some degree for higher death-rates. In proof of the assertion, we may state that twenty-two prisoners were sent to insane asylums during the

last eleven years, but less than thirty for the whole period before that time. In 1838 a case of insanity was spoken of as the second in ten years. Syphilis, on the other hand, is not so much more common as one would expect.

The substitution of solitary confinement as a punishment for flogging, in 1856, and giving up the out-of-door work in stone-cutting, in 1864, have been considered causes of increased mortality; but a glance at the first table shows conclusively that this could not have been the case. Undoubtedly, the present sedentary, indoor employment of many of the prisoners, especially where they are exposed to breathing dust, is injurious to health; but, even with an increased mortality, that is not so great an evil as idleness, and, under a contract-system of labor, must be considered as somewhat unavoidable,—to what degree it is not easy to say.

Confinement, routine, despondency, despair, the dyspepsia from eating in solitude,—all act with cumulative effect, as will be seen by the last table, but no more than they did twenty-five years ago.

The general care of the prisoners, including clothing, etc., etc., seems excellent, with the exception that they do not have enough active employment.

The food seemed to us good in quality, well cooked, abundant, and the diet more liberal than any others with which we have been able to compare it. In connection with the great prevalence of pulmonary consumption may be mentioned the small quantity of the fatty elements of food in the dietary; but this is a criticism which applies to all prisons, and consumption is the chief cause of death in nearly all of them. It may be interesting to compare the diet-list with that for convicts at industrial employment in prisons in Great Britain. In the latter, each prisoner has a prescribed quantity of food; at Charlestown, he has all that he wishes.

DIET AT THE MASSACHUSETTS STATE PRISON.

<i>Breakfast,</i>	Sunday,	Rice and molasses, white bread, coffee.
	Monday,	Fish-hash, white bread, coffee.
	Tuesday,	Meat-hash, white bread, coffee.
	Wednesday,	Potatoes, salt pork, white bread, coffee.
	Thursday,	Meat-hash, white bread, coffee.
	Friday,	Fish-hash, white bread, coffee.
	Saturday,	Meat-hash, white bread, coffee.

<i>Dinner</i> , . . .	Sunday, . . .	Meat-hash, graham bread, coffee.
	Monday, . . .	Corned beef, vegetables, white bread.
	Tuesday, . . .	Baked beans, brown bread.
	Wednesday, . .	Beef soup, white bread.
	Thursday, . . .	Pea soup, white bread.
	Friday,	Baked beans, brown bread.
	Saturday, . . .	Pea soup, white bread.
<i>Supper</i> ,		White bread, coffee.

DIET IN PRISONS IN GREAT BRITAIN.

<i>Breakfast</i> , . .	Three-quarters of a pint cocoa, bread.
<i>Dinner</i> , . . .	Sunday, Four ounces cheese, bread.
	Monday, Four ounces of mutton, half ounce of onions with bread, one pound potatoes, bread.
	Tuesday, One pint soup, made of eight ounces shin of beef, 1 ounce pearl barley, three ounces of fresh vegetables; one pound potatoes, bread.
	Wednesday, . . . Same as Monday.
	Thursday, . . . One pound suet pudding, made of one and a half ounces suet, eight ounces of flour, six and a half ounces water; one pound potatoes, bread.
	Friday, Four ounces of mutton, half ounce of onions with bread, one pound potatoes, bread.
	Saturday, Same as Friday.
<i>Supper</i> ,	One pint oatmeal gruel, bread.

The one great want in the prison is pure air. In the hospital, when it is full, seven beds are now necessarily occupied which are objectionable. For the rest, the room is ample (20,400 cubic feet in the ward, and 580 in each separate cell), sufficient ventilation could be accomplished by open windows, and there is an abundance of sunshine. Twelve patients can be accommodated there; and, for that number, the hospital is not open to serious objection, although windows and wooden ceilings in all the cells and a water-closet easy of access are to be desired.

In the lower arch for punishment, and for confinement of dangerous cases, and in the cells of the upper arch (all of this in the west wing), we find too little warmth or ventilation, or both.

Of the 652 cells in the three wings, we have seen that about one-fourth or one-fifth must be vacant in order to keep the

death-rate low, and this is very readily explained. In such case, a large number of cells would be left unoccupied in the north or old wing (built in 1829). The prisoners often complain of this wing as causing headache, nausea, etc., and the visiting physicians corroborate their testimony. In 1837, there were twenty-three cases of bleeding from the lungs, and fifteen of them were from the north wing.

From the accompanying table will be seen the relative accommodations of the different wings:—

TABLE NO. V.

WINGS.	Space in the corridors in cubic feet.	Space in the corridors to each convict.	Space in each cell in cubic feet.
South wing,	135,000	900	309 $\frac{1}{2}$
West wing (cells are not all of one size),	99,000	500	309 $\frac{1}{2}$ & 330
North wing,	139,840	460	171 $\frac{1}{2}$

The estimated size for cells in the proposed new prison is 396 cubic feet. Suppose that the space now occupied by 304 cells of 171 $\frac{1}{2}$ cubic feet each in the north wing were entirely reconstructed, even upon the basis of the south wing, there would then be room for only 174 cells, or 130 less than are now there. Even then the space to each prisoner in the open corridors would be only eight-ninths of that which each man has in the south wing. In such case, the prison, which now contains 689 convicts, has room enough for only 524 (say 500); and the hospital is about half large enough for the present number of convicts.

The ventilation in all the wings is defective; or, rather, ventilation, which consists in removing foul air and introducing fresh air, does not exist at all. The foul air is diffused pretty generally, and a certain condition of impurity is reached and remains rather constant.

In the south wing, the amount of air in the corridors and the large amount of air in the central guard-room (78,000 cubic feet), which connects freely by open bars with all the wings, probably obviates the difficulty to some extent for that

wing; but in the west, and especially in the north wing, there are conditions which, we think, call for some remedy. The evils of bad ventilation are aggravated from the fact that the buckets in the cells are of wood, with loose covers, and not provided with ventilating-shafts to carry off bad odors.

When the steam had been shut off long enough for the pipes to become cool, the air-meter indicated almost no circulation in the corridors; and, in the majority of the cells, the index did not move on placing the anemometer close to the ventilator. In some cases, there was found to be a draft of air coming into the cell from the ventilators; while, directly opposite the perpendicular ventilating-shafts, there was generally a feeble draft outwards. When the steam-pipes were heated, the condition was somewhat improved.

The following analyses, by Prof. W. Ripley Nichols, of the Massachusetts Institute of Technology, confirm the results obtained by the air-meter. The carbonic acid does not represent, by any means, all the impurities in the air; but it is, in the present state of science, the best attainable index of those impurities.

TABLE No. VI.

Amount of Carbonic Acid in parts per 1,000.

Examinations of air, night of February 9. Corridors, close to cell-doors:—

10 P. M.	North wing, below,	.	.	.	.	.	.	0.942
	“ “ above,	.	.	.	.	.	.	1.13
	South wing, below,	.	.	.	.	.	.	0.84
	“ “ above,	.	.	.	.	.	.	1.00
1 A. M.	North wing, below,	.	.	.	.	.	.	0.98
	“ “ above,	.	.	.	.	.	.	1.09
	South wing, below,	.	.	.	.	.	.	0.95
	“ “ above,	.	.	.	.	.	.	0.88
5 A. M.	North wing, below,	.	.	.	.	.	.	0.95
	“ “ above,	.	.	.	.	.	.	1.04
	South wing, below,	.	.	.	.	.	.	0.94
	“ “ above,	.	.	.	.	.	.	1.04

Examinations Monday, February 15, after the prisoners had spent the greater part of one day and night in their cells:—

7 A. M.	North wing, upper corridor, outside of cells,	. . . . .	1.02
	Cell in North wing, top row,	. . . . .	1.46
	“ “ bottom row,	. . . . .	0.79
	“ South wing, top row,	. . . . .	1.33
	“ West wing, bottom row,	. . . . .	0.95
	West wing, lower floor, outside of cells,	. . . . .	1.21
	Solitary cell,	. . . . .	1.01
Feb. 11.	Brush Factory, down stairs,	. . . . .	0.86
	“ up stairs,	. . . . .	1.56
	Tucker Manufacturing Company's room,	. . . . .	0.89
	Bronzing-room,	. . . . .	1.16
	Bedstead shop,	. . . . .	0.91
	First School-room,	. . . . .	1.69
	Third School-room,	. . . . .	1.39
	Cutting-room (doors open),	. . . . .	0.63

Analyses for comparison :—

Average London air,	. . . . .	0.047
“ of 339 mines in England,	. . . . .	0.785
Bedroom (M. Leblanc), A. M.,	. . . . .	0.4
Opera Comique (Paris), pit,	. . . . .	2.3
Salle d'Asyle (Paris),	. . . . .	2.7
Average of 15 grammar schools, Boston,	. . . . .	0.144
Public Library, waiting-room, Boston,	. . . . .	0.193

It will be seen that the cells on the top corridors are the worst ventilated, but that none of them are as bad as the school-room; and it must be remembered that, between shops, school-rooms and cells, the prisoners have scarcely a chance to breathe pure air.

In conclusion, we would say that, although there are many defects which would be remedied if a new prison were to be built, yet, as far as we can see, there are none so serious as not to admit of remedies.

To recapitulate, we would respectfully represent that there are now four powerful influences tending to cause bad health among the prisoners :—

1. The present overcrowding of the convicts.
2. The bad ventilation of the various apartments.
3. The very offensive condition of the prison-sewage, which is now allowed to escape openly on the flats immediately adjacent to the walls.

ERRATUM. — 0.047, 0.785, 0.144, 0.193, page 378, lines 17, 18, 22 and 23, should be 0.47, 7.85, 1.44 and 1.93.

4. The flats themselves,—open as they are to sewage from adjacent sewers.

It is somewhat hazardous to make predictions; but we think that, unless some remedy is adopted for the present evils, we shall have in the future only an increase of our present mortality, and that we shall be fortunate if no severe epidemic occurs.

All of which is respectfully submitted,

HENRY I. BOWDITCH.
RICHARD FROTHINGHAM.
CHARLES F. FOLSOM.

FEBRUARY 20, 1875.

At a meeting of the State Board of Health, held to-day, the above report was adopted and ordered to be sent to the legislative Committee on Prisons.

CHARLES F. FOLSOM,
Secretary.

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